Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

SYLLABUS for M. Sc. CHEMISTRY

Choice Based Credit System (Semester Pattern)

With effect from 2023-24 as per NEP 2020

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

SYLLABUS for M. Sc. CHEMISTRY

As per National Education Policy (NEP)-2020

With effect from 2023-24

Pre-requisites to enrol for the M. Sc. Chemistry Programme:

The student who has completed the three-year B. Sc. course with Chemistry (or allied subject) as the major subject with not less than 50% of aggregate marks (45% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol for M. Sc. (Chemistry) course. However, the student who has completed four-year B. Sc. course [B. Sc. (Honours) as per NEP- 2020] with Chemistry (or allied subject) as the major subject with not less than 50% of aggregate marks (45% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol directly in semester III of M. Sc. (Chemistry) course.

Credit distribution structure for two years Post Graduate Programme in Chemistry*

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT/FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6.0	Sem. I	14 (2 theory + 2 practical)	4	4			22	PG Diploma (after 3 Yr Degree)
		Sem. II	14 (2 theory + 2 practical)	4		4		22	
Cum. Cr. For PG Diploma/ 1 year of PG			28	8	4	4	-	44	
Exit option: PG Diploma 44 credits after three-year degree									
II	6.5	Sem. III	14 (3 theory + 1 practical)	4			4	22	PG Degree After 3 Yr UG or PG degree after 4-Yrs UG
		Sem. IV	14 (3 theory)	4			6	22	
Cum. Cr. For II year of PG			26	8			10	44	
Cum. Cr. For 2 year of PG degree			54	16	4	4	10	88	

*Source: [illegible]

Scheme of teaching and examination for M. Sc. CHEMISTRY (CBCS) As per NEP 2020

Structure and Credit Distribution of PG Degree Program for Two years

Choice Based Credit System (Semester Pattern)

With Effect from 2023-2024

M. Sc. CHEMISTRY Semester I

Course Category	Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								SEE	CIE		Theory	Practical
DSC	MCH1T01	Paper 1: Inorganic Chemistry	4	-	4	4	3	80	20	100	40	-
DSC	MCH1T02	Paper 2: Physical Chemistry	4	-	4	4	3	80	20	100	40	-
DSE	MCH1T03	Paper 3: Electives (Choose any one) (a) Bioinorganic Chemistry (b) Biomolecules (c) Foundations of Thermodynamics and Electrochemistry (d) Analytical Separation Techniques (e) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
RM	MCH1T04	Paper 4: Research Methodology	4	-	4	4	3	80	20	100	40	-
DSC	MCH1P01	Practical 1: Inorganic Chemistry	-	6	6	3	3-8	50	50	100	-	50
DSC	MCH1P02	Practical 2: Physical Chemistry (Including Research Methodology)	-	6	6	3	3-8	50	50	100	-	50
		TOTAL	**16**	**12**	**28**	**22**	–	**420**	**180**	**600**	**160**	**100**

CIE = Continuous Internal Evaluation and SEE = Semester End Examination

M. Sc. CHEMISTRY Semester II												
Course Category	Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								SEE	CIE		Theory	Practical
DSC	MCH2T05	Paper 5: Organic Chemistry	4	-	4	4	3	80	20	100	40	-
DSC	MCH2T06	Paper 6: Analytical Chemistry	4	-	4	4	3	80	20	100	40	-
DSE	MCH2T07	Paper 7: Electives (Choose any one) (a) Solid state and organometallic chemistry (b) Organic Reaction Mechanism (c) Quantum, Statistical and Nuclear Chemistry (d) Instrumental Methods of Analysis (e) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
OJT	MCH2P03	Practical 3: On Job Training/ Field Project	-	8	8	4	3-8	50	50	100	-	50
DSC	MCH2P04	Practical 4: Organic Chemistry	-	6	6	3	3-8	50	50	100	-	50
DSC	MCH2P05	Practical 5: Analytical Chemistry	-	6	6	3	3-8	50	50	100	-	50
		TOTAL	12	20	32	22	-	390	210	600	120	150

M. Sc. CHEMISTRY Semester III

Course Category	Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								SEE	CIE		Theory	Practical
DSC	MCH3T08	Paper 8:Spectroscopy-I	4	-	4	4	3	80	20	100	40	-
DSC	MCH3T09	Paper 9: Advanced Organic Chemistry-I	4	-	4	4	3	80	20	100	40	-
DSC	MCH3T10	Paper 10: Advanced Inorganic Chemistry	4	-	4	4	3	80	20	100	40	-
DSE	MCH3T11	Paper 11: Elective (Choose any one) (a) Inorganic Chemistry Special I (b) Organic Chemistry Special I (c) Physical Chemistry Special I (d) Analytical Chemistry Special I (e) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
DSE	MCH3P06	Practical 6: Based on Elective subject	-	4	4	2	3-8	50	50	100	-	50
RP	MCH3P07	Research Project (RP)	-	8	8	4	3-8	50	50	100	-	50
		TOTAL	**16**	**12**	**28**	**22**	-	**420**	**180**	**600**	**160**	**100**

M. Sc. CHEMISTRY Semester IV

Course Category	Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
								SEE	CIE		Theory	Practical
DSC	MCH 4T12	Paper 12: Spectroscopy-II	4	-	4	4	3	80	20	100	40	-
DSC	MCH 4T13	Paper 13: Advanced Organic Chemistry-II	4	-	4	4	3	80	20	100	40	-
DSC	MCH 4T14	Paper 14: Advanced Physical Chemistry	4	-	4	4	3	80	20	100	40	-
DSE	MCH 4T15	Paper 15: Elective (Choose any one) (a) Inorganic Chemistry Special II (b) Organic Chemistry Special II (c) Physical Chemistry Special II (d) Analytical Chemistry Special II (e) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
RP	MCH 4P08	Research Project (RP)	-	12	12	6		100	100	200	-	100
		TOTAL	**16**	**12**	**28**	**22**	-	**420**	**180**	**600**	**160**	**100**

Elective papers:

In addition to the mandatory papers, the student has to opt for ONE elective paper in each semester from the basket of elective papers mentioned in the following table

Basket for Elective Courses (4 Credits each)

Semester	Course Category	Name of the course	Course Code
I	Elective	(a) Bioinorganic Chemistry (b) Biomolecules (c) Foundations of Thermodynamics and Electrochemistry (d) Analytical Separation Techniques (e) Equivalent MOOC course	MCH1T03 (Paper 3)
II	Elective	(a) Solid state and organometallic chemistry (b) Organic Reaction Mechanism (c) Quantum, Statistical and Nuclear Chemistry (d) Instrumental Methods of Analysis (e) Equivalent MOOC course	MCH2T07 (Paper 7)
III	Elective	(a) Inorganic Chemistry Special I (b) Organic Chemistry Special I (c) Physical Chemistry Special I (d) Analytical Chemistry Special I (e) Equivalent MOOC course	MCH3T11 (Paper 11)
IV	Elective	(a) Inorganic Chemistry Special II (b) Organic Chemistry Special II (c) Physical Chemistry Special II (d) Analytical Chemistry Special II (e) Equivalent MOOC course	MCH4T15 (Paper 15)

The students can opt either the elective paper taught in the college in offline mode or any other equivalent online course of at least 4 credits offered by MOOC or any other such platform. The equivalence of such courses will be decided by the college committee comprising of the faculty members of the department and chaired by the Head, Dept. of Chemistry in that College.

EVALUATION and DISTRIBUTION OF MARKS

(1) Continuous Internal Evaluation (CIE): Twenty (20) marks in theory based on overall participation (Such as, Attendance in theory and practical classes, seminar, assignment, quiz, participation in field tours, conferences, workshops, and the general behaviour in the department.)

(2) Semester End Examination (SEE)

Theory Paper: Maximum Marks: 80, Duration of Examination-Three Hours. The paper will be set so as to cover all units/sections of the syllabus as below:

Type of questions	Total Number of questions	No. of questions to be answered	Marks for Each Question	Total maximum marks
• Short answer questions • Long answer questions • Numerical questions • Analytical questions	4 + 1 = 5 one question from each unit (4) + one question on all the units (1)	5	16	80

(3) General Scheme for Distribution of Marks in Practical Examination in Chemistry

Time: 6-8 h (One day Examination) Marks:100

Exercise-1	15 Marks	- Evaluated jointly by Internal and External Examiner
Exercise-2	15 Marks	- Evaluated jointly by Internal and External Examiner
Record	10 Marks	- Evaluated by Internal
Viva-Voce	10 Marks	- Evaluated by External
SEE	**50 Marks**	
CIE	**50 Marks**	
Total	**100 marks**	

(4) General Scheme for Distribution of Marks in Project Examination in Chemistry

The project work will be evaluated by both external and internal examiners. The examiners will evaluate the project work considering the coverage of subject matter, presentation, literature etc.

Written Project work	-	Evaluated jointly by External and Internal
For Presentation	-	Evaluated jointly by External and Internal
ForViva-Voce	-	Evaluated by External Examiner
Internal Assessment	-	Evaluated by Internal Examiner

Sem-III: Total 100 Marks (50 CIE and 50 SEE)

Sem-IV: Total 200 marks (100 CIE and 100 SEE)

Teacher and research project supervisor:

The regular full-time subject teacher of the College / Approved Contractual teacher / Approved Adhoc faculty / Approved Contributory teacher /scientist of government or private research laboratory appointed by university as a contributory teacher and having M. Phil. or Ph. D. degree in Chemistry can supervise the research project of the student.

SEMESTER I

Paper 1

MCH1T01: Inorganic Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course students would be able to

1. *predict the nature of bond and its properties through various electronic structural methods; bonding models*
2. *design new coordination compounds based on a fundamental understanding of their electronic properties*
3. *develop the possible catalytic pathways leading to desired products*
4. *apply the principles of transition metal coordination complexes to derive reaction mechanisms.*

Unit I

Electronic spectra and MO theory of Transition Metal complexes

Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule, Hole formalism, Determination of the term symbol (ground and excited states) for d^1 to d^9 configurations, Electronic spectra of transition metal complexes, Laporte 'orbital' selection rule, spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d^2 and d^8 configuration. M.O. Theory for octahedral, tetrahedral and square planar complexes with and without π-bonding.

Unit II

A) Boron hydrides: Classification, nomenclature, structure, bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for higher boranes and their utilities. Chemistry of diboranes: Study of Carboranes and Metallocarboranes with reference to preparations and structures.

B) Metal-Metal bonds: Occurrence of metal-metal bond, Classification of metal clusters, Binuclear, trinuclear, tetranuclear, pentanuclear and hexanuclear with reference to halide, oxide, alkoxide and acetate clusters.

Unit III

A) Metal – Ligand Equilibria in Solution: Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodynamic origin. Determination of formation constant by:

(1) spectrophotometric method (Job's and Mole ratio method)

(2) Potentiometric method (Irving-Rossotti Method)

B) Reaction Mechanism of Transition metal complexes-I: Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution: Acid hydrolysis, factors affecting acid hydrolysis, Stereochemistry of intermediates in S_N1 and S_N2, Base

hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, Annation reaction, reaction without metal-ligand bond breaking.

Unit IV

A) Metal carbonyls: EAN concept and 18-electron rule for metal carbonyls, Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, synthesis and structures.

B) Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes.

References

1. S. F. A. Kettle, J. N. Murral and S. T. Teddler: Valency Theory
2. C. A. Coulson: Valency
3. J. E. Huheey: Inorganic Chemistry
4. F.A. Cotton and G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5thand 6th Editions.
5. A. F. Willims: Theoretical Approach in inorganic chemistry.
6. A. Mannas Chanda: Atomic Structure and chemical Bonding
7. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
8. J. J. Logowski: Modern Inorganic Chemistry
9. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
10. J. C. Bailar: Chemistry of coordination compounds.
11. W. L. Jolly: Modern Inorganic Chemistry
12. R. S. Drago: Physical methods in inorganic chemistry.
13. Waddington: Nonaqueous solvents.
14. Sisler: Chemistry of nonaqueous solvents.
15. A. K. Barnard: Therotical Inorganic Chemistry
16. Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.
17. F. A. Cotton: Chemical Applications of Group theory.
18. Jones: Elementary Coordination chemistry.
19. B. N. Figgis: Introduction to Ligand field.
20. S. F. A. Kettle: Coordination chemistry.
21. M.C.Day and J.Selbin: Theoretical Inorganic Chemistry.
22. J. Lewin and Wilkins: Modern Coordination Chemistry.
23. Gowarikar, Vishwanathan and Sheedar: Polymer science.
24. H. H. Jattey and M. Orchin: Symmetry in chemistry.
25. D. Schonaland: Molecular Symmetry in chemistry.
26. L. H. Hall: Group theory and Symmetry in chemistry
27. H. H. Jattey and M. Orchin: Symmetry in chemistry
28. R.L.Dutta and A.Symal: Elements of magneto chemistry
29. Inorganic Chemistry 4th Edition, P.Atkins, Oxford University Press.
30. Essential Trends in Inorganic Chemistry, D.M.P.Mingos, Oxford University Press.
31. Purcell and Kotz: Inorganic Chemistry, Cengage Publishers.
32. Puri, Sharma, Kalia: Principles of Inorganic Chemistry, Milestone Publishing.
33. Madan, Malik, Tuli, Selected topics in Inorganic Chemistry.
34. Agarwal and Kimtilal: Advanced Inorganic Chemistry, Pragati Prakashan.

SEMESTER I

Paper 2

MCH1T02: Physical Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Understand, analyze and exercise the principles of classical thermodynamics in various applications*
2. *Understand and execute the quantum mechanical problems and their applications*
3. *Understand the concept of adsorption and its application in surface chemistry*
4. *Analyze and understand the characterization techniques for polymer*
5. *Understand the principles of chemical kinetics and their applications in chemical dynamics*

UNIT I :CLASSICAL THEMODYNAMICS

A) Recapitulation of Laws of thermodynamics, Exact and inexact differentials, condition of exactness, Ptaff differential expression and equations, Applications of Ptaff differential equations to first and second law of thermodynamics, Carathéodory's principle and its equivalence to the Kelvin Plank and Clausius statement of the Second law of Thermodynamics, Homogeneous functions of degree 0 and 1, extensive and intensive properties, derivation of thermodynamic equations of state, Maxwell's relations .Third law of thermodynamics, Nernst Heat Theorem, unattainability of absolute zero, calculation of entropy based on third law of thermodynamics, residual entropy and its application, Numerical.

UNIT II :FORMULATION OF QUANTUM MECHANICS

A) Introduction of Quantum Mechanics, Wave Function, Acceptability of Wave Functions, Normalized and Orthogonal Wave Functions, Operators, Operator Algebra, Eigen Functions and Eigen Values of Quantum Mechanical Properties)e.g .Linear, Angular momentum, etc(., Hermitian Operators, Orbital and generalized Angular Momentum, Postulates of Quantum Mechanics, Problems on Operator algebra, Eigen Values and Average Values of quantities.

B) Application of Schrödinger Wave Equation to Simple Systems :Particle in a 3-Dimensional Box, Concept of degeneracy and breakdown in degeneracy, Rigid Rotor, Potential Well of Finite Depth)Tunneling Effect(, Simple Harmonic Oscillator, The Hydrogen Atom.

UNIT III :SURFACE CHEMISTRY AND MACROMOLECULES

A) Recapitulation of Surface tension, Adsorption :Freundlich adsorption isotherm, Langmuir theory, Gibbs adsorption isotherm, BET theory and estimation of surface area, enthalpy and entropy of adsorption .Surface film on liquids and catalytic activity, Electro-kinetic phenomena, Surface active agents, hydrophobic interactions, micellization, Critical Micelle Concentration)CMC(, mass action model and phase separation model of micelle formation, shape and structure of micelles, factors affecting CMC, micro-emulsion and reverse micelles.

B) Definition of macromolecule (Polymer), types of polymers, Number average and mass average molecular mass, molecular mass determination by Osmometery, Viscometry, Ultracentrifugation, light scattering and size-exclusion chromatography method, Numericals.

UNIT IV :CHEMICAL KINETICS

A(Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates.

B(Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions **:**Lindeman**-**Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation**.**

References

1. R **.**P **.**Rastogi and R **.**R **.**Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010**.**
2. P **.**W **.** Atkins and D **.**Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010**.**
3. E **.**N **.** Yenemin, Fundamentals of Chemical Thermodynamics, MIR, Publications**.**
4. G **.**K **.**Vemulapalli, Physical Chemistry, Prentice –Hall of India, 1997**.**
5. S **.** Glasstone and De Van No Strand, Thermodynamics for Chemists, 1965**.**
6. S **.**M **.**Blinder, Advanced Physical Chemistry,
7. D **.**Mcquarie and J **.**Simon, Physical Chemistry –A Molecular Approach, University Press, 2000
8. Ira N .Levine, Quantum Chemistry, 5th edition)2000(, Pearson educ., Inc.New Delhi
9. A.K.Chandra, Introductory Quantum Chemistry, 4th edition)1994(, Tata Mcgraw Hill, New Delhi.
10. M.W.Hanna, "Quantum Mechanics in Chemistry", Benjamin
11. L .Pualing and E .B .Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York)1935.(
12. R .K .Prasad, Quantum Chemistry, New Age International, Delhi .
13. R .K .Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
14. B .C .Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
15. G **.**M **.**Barrow, Physical Chemistry, Tata Mc**-**Graw Hill, V edition 2003**.**
16. H **.**K **.**Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010**.**
17. G. M. Panchenkov and V.P. Labadev, "Chemical Kinetics and catalysis", MIR Publishing
18. E.A .Moelwyn -Hughes, "Chemical Kinetics and Kinetics of Solutions", Academic
19. K. J .Laidler, Chemical Kinetics, Third Edition)1987(, Harper and Row, New York.
20. J. Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi)1993(

21. C .H .Bamford and C .F .H .Tipper, Comprehensive Chemical Kinetics, **Vol 1**., Elsevier Publications, New York, 1969.
22. C .H .Bamford and C .F .H .Tipper, Comprehensive Chemical Kinetics, **Vol 2**., Elsevier Publications, New York, 1969.
23. S .Glasstone, K .J .Laidler and H .Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
24. A .Findley, The Phase Rule and its Applications, Longmans Green and Co., Mumbai.
25. K .S .Birdi, Surface Chemistry Essentials, CRC Press, New York, 2014.
26. Eric KeightleyRideal, An Introduction to Surface Chemistry, Cambridge University Press, 1926.
27. D .M .Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley and Sons, NewYork, 1984.
28. A .W .Adamson, A .P .Gasi, Physical Chemistry of Surfaces, Wiley, 2007.
29. P .C .Hiemenz and R .Rajagopalan, Principles of Colloid and Surface Chemistry, CRC Taylor and Fransis, 2007.
30. P .D .Hede and S .P .Beier, Inorganic and Applied Chemistry, e-Book, 2007.
31. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
32. E.M .Mc Cash, Surface Chemistry, Oxford University Press, Oxford)2001.(
33. G .K .Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill, 1990.
34. N .B .Singh, N .S .Gajbhiye, S .S .Das, Comprehensive Physical Chemistry, New Age International, 2014.
35. K .L .Kapoor, Text Book of Physical Chemistry, Vol –I to Vol-VI, 2011.
36. Spectroscopic identification of organic compound-RM Silverstein,GCBassler and TC Morril, John Wally
37. Application of Spectroscopy to Organic Compound-J .R .Dyer, Printice Hall
38. Organic Spectroscopy-William Kemp, ELBS with McMillan
39. Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
40. Organic Spectroscopy-RT Morrison and RN Boyd
41. Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
42. Fundamentals of Molecular Spectroscopy-CN Banwell

NPTEL sources weblinks

For Quantum Chemistry Introduction:

- https://archive.nptel.ac.in/courses/104/108/104108057/
- https://onlinecourses.nptel.ac.in/noc20_cy27/preview
- https://nptel.ac.in/courses/104106083
- https://nptel.ac.in/courses/104108057
- https://www.digimat.in/nptel/courses/video/104108057/L11.html

For Chemical Kinetics

- https://archive.nptel.ac.in/courses/104/101/104101128/
- https://www.youtube.com/watch?v=uep2XeLCGkc

SEMESTER I

Paper 3 (Elective)

MCH1T03: (a) Bioinorganic Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student would be able to

1. *apply the principles of transition metal coordination complexes in understanding functions of biological systems*
2. *identify the medicinal applications of inorganic compounds*
3. *understand mechanism of energy transfer processes in biological systems*
4. *develop the possible enzymatic pathways in biosystems*
5. *explain oxygen transport mechanisms in biosystems*

Unit I

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and deficiency of V, Cr, Mn, Fe, Co, Cu and Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na+ /K+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics and related compounds. Metal used for diagnosis and chemotherapy with particular reference to anti-cancer drugs.

Unit II

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes and Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit III

Transport and Storage of Dioxygen: Heme proteins and oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins and hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoning and treatment. Vanadium storage and transport.

Unit IV

Metallo-enzymes: Apoenzymes, Haloenzyme and Coenzyme. The principle involved and role of various metals in i) Zn-enzyme: Carboxyl peptidase and Carbonic anhydrase. ii) Fe-enzyme: Catalase Peroxidase and Cytochrome P-450 iii) Cu-enzyme: Super Oxide dismutase iv) Molybdenum: Oxatransferase enzymes, Xanthine oxidase, Co-enzyme Vit.B_{12}, Structure of vitamin B_{12}, Co-C bond

cleavage, Mutase activity of coenzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetic model of enzyme action, stability and ageing of enzyme.

References

1) Akhmetov, N.: General and Inorganic Chemistry
2) Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3) Bertini, et al: Bioinorganic Chemistry
4) Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (John Wiley).
5) Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6) Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7) Fenton, David E.: Biocoordination chemistry, Oxford
8) Jolly, W. L. Inorganic Chemistry (4th edn) Addison-Wesley
9) Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions (J.Wiley)

SEMESTER I

Paper 3 (Elective)

MCH1T03: (b) Biomolecules

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Draw the structures of essential biomolecules*
2. *Understand the role of biomolecules in various life processes*
3. *Understand the way how drug can be administrated, absorbed, distributed and metabolized*
4. *Understand the relation of drug with different types of receptors, chemical messengers, binding site and DNA.*

Unit I:

Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, configurations of aldoses and ketoses, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, Structural features and applications of inositol, starch, cellulose, chitin and heparin

Unit II:

Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, end group analysis, strategy of peptide bond synthesis: *N*-Protection and *C*-Activation, Solid phase peptide synthesis

Unit III:

Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation, Biosynthesis of DNA and RNA, Polymerase Chain Reaction (PCR) and RTPCR

Lipids: Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospholipids, spingolipids, lipoproteins, composition and function, role in atherosclerosis Properties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biological membranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

Unit IV: Enzyme chemistry

A) **Enzymes:** Introduction, chemical and biological catalysis, remarkable properties of enzymes likecatalytic power, specificity and regulation. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Nomenclature and classification, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker's yeast catalysed reactions

B) **Mechanism of Enzyme Action:** Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A

C) Vitamins and Co-Enzyme Chemistry: Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+, $NADP^+$, FMN, FAD, lipoic acid, biotin as CO_2 carrier. Mechanisms of reactions catalyzed by the above cofactors

References

1) Bioorganic Chemistry :A Chemical Approach to Enzyme Action, Hermann Dugas and C .Penny, Springer-Verlag
2) Understanding Enzymes, Trevor Palmer, Prentice Hall
3) Enzyme Chemistry :Impact and Applications, Ed .Collin J .Suckling, Chapman and Hall
4) Enzyme Structure and Mechanism, A .Fersht, W .H .Freeman
5) Introduction to Medicinal Chemistry, A .Gringuage, Wiley-VCH
6) Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F .Dorge
7) Strategies for Organic Drug Synthesis and Design, D .Lednicer, John Wiley

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Weblink to Equivalent MOOC on NPTEL/SWAYAM if relevant:

- Essentials of Biomolecules: Nucleic Acids and Peptides https://nptel.ac.in/courses/104/103/104103121/
- Biocatalysis in Organic Synthesis https://archive.nptel.ac.in/courses/104/105/104105032/
- Biochemistry https://archive.nptel.ac.in/courses/104/105/102105034/
- Organic Chemistry in Biology and Drug Development https://archive.nptel.ac.in/courses/104/105/104105120/

SEMESTER I

Paper 3 (Elective)

MCH1T03: (c) Foundations of Thermodynamics and Electrochemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Understand, the mathematical concepts used in chemistry*
2. *Understand the principle involved in fundamental physical chemistry*
3. *Understand the concept of ideal and non-ideal solutions*
4. *Understand the theories of electrolytes*

Unit-I: Mathematical concepts

Equation of a straight line and calculation of slope and intercepts, Differentiation, Derivative function, various differential formulas, Chain rule, finding minima and maxima, partial differentiation. Integration, methods of integration, integration by parts, integration formulas, permutation combination fundamentals, Vectors, Matrices, Determinants, Complex numbers, series expansions, Stirling approximation, Practice numerical based on these concepts.

Unit II :Thermodynamics and Phase Equilibria

Concept of fugacity, determination of fugacity, The Le-Chatelier's Principle and its quantitative treatment. Ideal solutions and Roult's law, non-ideal solutions (Henry's Law), Deviation from ideal behavior, Chemical potential in Non-ideal solutions, excess functions for non-ideal solutions, Partial molar quantities **:**Determination of partial molar quantities, chemical potential, partial molar volume, Gibbs- Duhem equation, Gibbs Duhem Mergules equation Entropy of mixing, Enthalpy of mixing, Fractional Distillation, Distillation of Azeotropic Mixtures.

Unit-III: The Phase Rule

Recapitulation of Gibbs Phase rule (Without Derivation), degrees of freedom, reduced phase rule, construction of phase diagram, one component systems **)**Water, Sulphur, carbon**(**, 1st and 2nd order phase transition, lambda line, Helium,system, Eutectic systems, two component systems forming solid solutions having congruent and incongruent melting point, Construction of a phase diagram, partially miscible solid phase, three component systems, graphical presentation, related Numerical

Unit-IV: Electrochemistry - I

Electrolytic conductance (Specific, Equivalent and molar), Variation of Eq./molar conductance with dilution, Transport number and its determination using Hittorf's method and Moving boundary method, Kohlrausch's law, calculation of molar ionic conductance, conductometric titrations, High frequency titrations, Ostwald dilution law, Determination of ionic mobility, numerical. Principle of potentiometry, Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes: Calomel electrode and Ag/AgCl electrode. potentiometric titrations, Nernst equation, standard electrode potential, Determination of cell potential, n, Kf and Ksp. pH titrations.

References

1. R .P .Rastogi and R .R .Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
2. P .W .Atkins and D .Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
3. E .N .Yenemin, Fundamentals of Chemical Thermodynamics, MIR, Publications.
4. G .K .Vemulapalli, Physical Chemistry, Prentice –Hall of India, 1997.
5. S .GlasstoneandDe Van No Strand, Thermodynamics for Chemists, 1965.
6. S .M .Blinder, Advanced Physical Chemistry,
7. D .Mcquarie and J .Simon, Physical Chemistry –A Molecular Approach, University Press, 2000
8. Ira N .Levine, Quantum Chemistry, 5th edition)2000(, Pearson educ., Inc.New Delhi
9. G .M .Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.

A. Findley, The Phase Rule and its Applications, Longmans Green and Co., Mumbai.

10. N .B .Singh, N .S .Gajbhiye, S .S .Das, Comprehensive Physical Chemistry, New Age International, 2014.
11. K .L .Kapoor, Text Book of Physical Chemistry, Vol –I to Vol-VI, 2011.
12. Spectroscopic identification of organic compound-RM Silverstein, GCBassler and TC Morril, John Wally
13. Application of Spectroscopy to Organic Compound-J .R .Dyer, Printice Hall

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NPTEL sources Weblinks

For Classical Thermodynamics:

- https://archive.nptel.ac.in/courses/104/103/104103112/
- https://digimat.in/nptel/courses/video/104106094/L18.html

For Phase rule:

- https://www.youtube.com/watch?v=2LywAiZBQW4
- https://archive.nptel.ac.in/courses/113/104/113104068/
- https://archive.nptel.ac.in/courses/104/103/104103112/

For electrochemistry

- https://onlinecourses.nptel.ac.in/noc23_cy19/preview
- https://www.youtube.com/watch?v=XTt3gXB0a84

SEMESTER I

Paper 3 (Elective)

MCH1T03: (d) Analytical Separation Techniques

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course students will be able to

1. *Understand various separation technique based on sample and target analyte*
2. *Elaborate the working principles of various separation techniques.*
3. *Apply logic behind working and applicability of each technique.*
4. *Identify most suitable separation tool resolution of mixtures.*
5. *Develop separation methods for multicomponent analysis.*
6. *Evaluate efficiency of separation of mixture based on analysis parameters.*

Unit I: Column, paper and thin layer chromatography

Definition and general classification of chromatographic techniques**.** Normal and reverse phase chromatography. Terminology used in separation techniques.

Column chromatography: Basic principle, technique and applications in qualitative and quantitative analysis. Properties of good column adsorbents.

Paper chromatography: Basic principle, techniques and applications in qualitative and quantitative analysis. Calculations involving R_f values.

Paper electrophoresis: Principle and technique. Factors affecting migration of ions. Applications.

Thin layer chromatography: Principle and technique. Advantages over paper and column chromatography. Applications.

Unit II: Ion exchange and solvent extraction

Ion exchange: Principle and technique**.** Types of ion exchangers and their structures**.** Ion exchange equilibria and action of cation and anion exchange resins**.** Factors affecting ion exchange efficiency. Ion exchange capacity**.** Experimental determination of ion exchange capacities of cation and anion exchange resins. Effect of complexing ions**.** Zeolites as ion**-**exchangers**.** Applications of ion exchange.

Solvent extraction: Principle and techniques**.** Distribution ratio and distribution coefficient**.** Factors affecting extraction efficiency**:** Ion association complexes, chelation, synergistic extraction, pH**.** Numericals based on multiple extractions**.** Role of chelating ligands, crown ethers, calixarenes and cryptands in solvent extraction**.** Introduction to Solid phase extraction **(**SPE**)** and Microwave assisted extraction **(**MAE**)**, Applications**.**

Unit III: Gas Chromatography

Principle including concept of theoretical plates. Calculations involving number of theoretical plates and height equivalent of theoretical plates. Column resolution, retention factor and selectivity factor. van**-**Deemter equation. Factors affecting retention, peak resolution and peak broadening**.** Instrumental set up**-** carrier gas, sampling system, column and detector**.** Types of columns in GC: Packed and open tubular, their advantages and limitations**.** Detectors in GC analysis**.** Characteristics of ideal detectors.

Construction and working of thermal conductivity, flame ionization, electron capture and mass spectrometric detectors. Temperature programmed GC and its advantages**.**

Unit IV: Liquid Chromatography

HPLC**:** Principle of HPLC. Instrumentation including mobile phase injection system, sample injection system, column and detector. Types of columns and packing materials. Normal and reverse phase systems. Detectors in HPLC: Construction and working of UV detector, fluorescence detector, photodiode array detector**.** Principle and applications of size exclusion, gel permeation and ion retardation chromatography**.** Comparison of HPLC with GC

Supercritical fluid chromatography**:** Principle, advantages and applications.

References

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley, India**).**
4. Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
5. Instrumental Methods of Analysis**:** Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
6. Introduction to Instrumental analysis: Robert Braun (Tata McGraw-Hill)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
9. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
10. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
11. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
12. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
13. Instrumental Methods of Chemical Analysis: G. W. Ewing

Web link for related NPTEL courses

Analytical Chemistry: https://nptel.ac.in/courses/104105084

SEMESTER I

Paper 4

MCH1T04: Research Methodology

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student will be able to

1. *understand what research is and what is not.*
2. *raise awareness of crucial aspect of the nature of Knowledge and the value of scientific method.*
3. *Introduce the concept at the heart of every research project – the research problem - and to discuss what a researchable problem is.*
4. *evaluate literature, form a variety of sources, pertinent to the research objectives.*
5. *identify and justify the basic components of the research framework, relevant to the tackled research problem.*
6. *explain and justify how researchers will collect research data.*
7. *discuss how to cite sources, and justify this choice.*
8. *put forward a credible research proposal, and*
9. *warn the common mistakes in the field of research methodology.*

Unit – I: Foundations of Research

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific, method - Understanding the language of Research - Concept, Construct, Definition, Variable. Research Process. Problem Identification and Formulation - Research Question – Investigation, Question - Measurement Issues - Hypothesis - Qualities of a good Hypothesis Null Hypothesis and Alternative Hypothesis. Hypothesis Testing - Logic and Importance. Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent and Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research - Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit – II: Statistical analysis for Chemists

Errors in chemical analysis. Classification of errors- systematic and random, additive and proportional, absolute and relative. Accuracy and precision. Mean, median, average deviation and standard deviation. Significant figures and rules to determine significant figures. Calculations involving significant figures. Confidence limit, correlation coefficient and regression analysis. Comparison of methods: F-test and T-test. Rejection of data based on Q-test. Least squares method for deriving calibration graph. Application of Microsoft Excel in statistical analysis (statistical functions and spreadsheets in MS-Excel). Validation of newly developed analytical method. Certified reference materials (CRMs). Numerical problems.

Unit – III:

A] Scientific Writing and Presentation

Scientific writing. Basics in Scientific grammar. Importance of abbreviations and acronyms. Types of scientific publications- magazines, journals, reviews, news-letters, structure of scientific paper. Various reference styles.

Report Writing, Significance of report writing, different steps in report writing, types of Journals and reports, layout of research paper.

Research Ethics (Issues relating to referencing and documentation, copyrights, plagiarism), Impact Factor, CiteScore, *h*-Index, i10-Index, Citation Index, references/bibliography, structuring the thesis, use of software in thesis writing.

B] Intellectual Property Rights (IPR)

Introduction to IPR (Patents, Trademarks, Geographical indicators, Copyright and neighbouring rights), Concept and theories, kinds of IPR, Economic analysis of IPR, Need for private rights versus public interests, Advantages and disadvantages of IPR.

Unit – IV: Use of tools / techniques for Research

Methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX, Beamer presentation, preparation of bibliography database, MS Word, MS Excel, Graph and chart preparation, MS Power Point, Microcal Origin, ChemSketch, ChemDraw, Other computational software like Guassian, Mathematica, Software for detection of Plagiarism.

References

1. Research Methodology- C. R. Kothari
2. Best and Kahn, Research Methodology, PHI Limited
3. Design of Experience: Statistical Principles of Research Design and Analysis, by Robert O. Kuehl Brooks/cole.
4. Patrick Carey, Katherine T. Pinard, Ann Shaffer, Mark Shellman, New Perspectives Microsoft Office 365 and Office 2019 Introductory, 2020.

SEMESTER I

Practical 1

MCH1P01: Inorganic Chemistry

6 h per week *100 Marks*

I. Preparation of Inorganic Complexes and their characterization by:

Elemental analysis and physico-chemical methods (Electronic and IR Spectra, magnetic susceptibility measurements, Thermal analysis and Molar conductance studies).

1. K_3 [Al $(C_2O_4)_3$]$(H_2O)_3$ 2. [VO (acac) $_2$] 3. Na [Cr $(NH_3)_2(SCN)_4$]

4. $K_3[Cr(SCN)_6]$. 5. [Mn (acac) $_3$] 6. K_3 [Fe $(C_2O_4)_3$]

7. Hg [Co (SCN) $_4$] 8. [Co (Py) $_2$ Cl_2] 9.$[Ni(NH_3)_6]Cl_2$ 10. [Ni (DMG) $_2$]

11. $[Cu_2 (CH_3COO)_4(H_2O)_2]$ 12. $[Cu(NH_3)_4(H_2O)_2]SO_4$

II. Quantitative Analysis:

Separation and determination of two metal ions from the following alloys involving:

Volumetric, Gravimetric and Spectrophotometric methods

i) Copper (II) and Nickel (II)

ii) Copper (II) and Zinc (II)

iii) Nickel (II)—Zinc (II) and

iv) Copper (II)—Iron (III)

III. Qualitative analysis of radicals:

Semimicro analysis of inorganic mixture containing four cations out of which two will be rare metal ions such as W, Mo,Se,Ti,Zr,Ce,Th,V and U.(Spot Test for individual cations shall be performed)

References

1. Practical Inorganic Chemistry - Pass
2. Practical Inorganic Chemistry - Marr and Rocket
3. Basic Concept Of Analytical Chemistry - Khopkar S. M.
4. Synthesis And Characterisation Of Inorganic Compounds – W. L. Jolly, Prentice Hall
5. Inorganic Experiments – J. Derck Woollins, Vch.
6. Practical Inorganic Chemistry – G. Marrand, B.W. Rockett, Van Nostrand
7. A Text Book Of Quantitative Inorganic Analysis – A.I. Vogel, Longoman.
8. Edta Titration – F. Laschka
9. Instrumental Methods Of Analysis – Willard, Merit And Dean (Cbs, Delhi)
10. Inorganic Synthesis – Jolly
11. Instrumental Methods Of Chemical Analysis – Yelri Lalikov
12. Fundamental Of Analytical Chemistry- Skoog D .A. And West D. M. Holt Rinehart And Winston Inc.
13. Experimental Inorganic Chemistry7 – W.G. Palmer, Cambridge

Practical 2

MCH1P02: Physical Chemistry including RM

6 h per week *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Understand the basic principle involved in physical chemistry.*
2. *Evaluate various physical parameters*
3. *Interprete the experimental results.*
4. *Calculation involved in inpreting results*

Understand the concept of Qualitative analysis

It is expected to perform minimum 14 experiments in a semester.

1. To study the variation of volume contraction with mole fraction of alcohol in alcohol -water system
2. To determine the activation parameters of viscous flow for a given liquid.
3. To Determine the critical micelle concentration)CMC (of a given surfactant /soap /shampoo by surface tension measurements .
4. Determination of molecular mass of a polymer by viscometry method.
5. To determine integral heat of KNO_3, at two different conc .and calculation of heat of dilution.
6. Effect of 1 %NaCl, 1 %succinic acid, 0.5 %naphthalene on CST in phenol-water systems.
7. Distribution of succinic acid in H_2O -benzene, H_2O-ether and comparison of distribution coefficient.
8. To construct the phase diagrams of two components system)phenol -urea, diphenyl aminebenzophenone; a-naphtyl amine-phenol (forming compounds with congruent melting points.
9. To study the mutual solubility of glycerol-m-toluidine and to determine congruent points.
10. To study kinetics of hydrolysis of an ester by NaOH reaction.
11. To determine equilibrium constant of the equation $KI+I_2=KI_3$ by distribution method.
12. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
13. Determination of order of reaction of oxidation of ethyl alcohol by acid dichromate.
14. To titrate conductometrically monobasic and dibasic acids with NaOH and determine the strength of given acid.
15. To determine equivalent conductance of weak electrolyte at infinite dilution by kaulrausch's method.
16. Determination of heat of reaction, entropy change and equilibrium constant of the reaction between metallic zinc and Cu^{+2} ions in solution.
17. Determination of thermodynamic constants ΔG, ΔH, ΔS for $Zn^{+2}+H_2SO_4 \rightarrow ZnSO_4 + 2H^+$ by emf measurement.
18. Titration of Ferrous Ammonium Sulphate against ceric sulphate and hence the formal redox potential of $Fe^{2+} \rightleftharpoons Fe^{3+}$ and $Ce^{3+} \rightleftharpoons Ce^{4+}$ systems .
19. To determine the pH of a buffer solutions using a quinhydrone electrode
20. RM-1: Statistical Analysis using MS Excel program (mean, average deviation, standard deviation, variance, F-test, t-test, chi-square test, correlation coefficient, slope, intercept, etc).
21. RM-2: Graph plotting through least square method and

22. RM-3: Molecular designing through Chemsketch and ChemDraw softwares in 2D and 3D formats (simple organic compounds and ions)
23. RM-4: Reference formatting using Mendeley and Zotero.
24. RM-5: Preparation and formulation of questionair for survey
25. RM-6: Sample collection methods

References

1. Vogel A **:** A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A**.** Alberty, Experimental Physical Chemistry, Mc**-**Graw Hill, Fifth Edition, 1956**.**
5. John W**.** Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood **:**Quantitative Analysis
7. Merits And Thomas**:**Advanced Analytical Chemistry
8. Ewing, G**.** W**. :** Instrumental Methods of Chemical Analysis, Mcgraw**-**Hill
9. Drago, R**.**S**:**Physical Methoods In Inorganic Chemistry
10. Christain G**.**D**:**Analytical Chemistry
11. Khopkar S**.**M**.:**Basic Concept Of Analytical Chemistry
12. Koltath And Ligane**:**Polorography
13. Braun**:**Instrumental Methods Of Chemical Analysis
14. Willard, Merritt And Dean**:** Instrumental Methods Of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi;Llan And Wisin**:** Analytiacl Chemistry
16. Skoog S**.**A**.** And West D**.** W**.:**Fundamental of Analytical Chemistry
17. Dilts R**.**V**.:** Analytiacl Chemistry
18. Jahgirdar D**.**V **:**Experiments In Chemistry
19. Chondhekar T**.**K**:** Systematic Experiments In Physical Chemistry, Rajbog S**.**W**.**, Aniali Pubn**.**
20. Wlehov G**.** J**:** Standard Methods Of Chemicalanalysis 6th Ed

SEMESTER II

Paper 5

MCH2T05: Organic Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Implement rules of aromaticity to organic molecules*
2. *Sketch organic molecules in different projection formula and assign its configuration.*
3. *Apply their understanding about the organic reactions of industrial significance with respect to the chemo- selectivity, regioselectivity and enantioselectivity.*
4. *Analyze the product distribution and the stereochemistry of various organic products.*
5. *Evaluate the relationship between structure and reactivity*

Unit I:

A) Nature and Bonding in Organic Molecule: Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyper-conjugation, Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π-molecules orbitals, annulenes, antiaromaticity, homoaromoaticity, Aromatic character and chemistry of cyclopentadienyl anion, tropylium cation, tropone and tropolone, Frost Circles (The Polygon Method) for drawing energy levels in cyclic pi systems**.**

B) Carbenes: Types of carbenes, Structure and reactivity of carbenes, Generation and reactions, insertion, addition, rearrangement reactions of carbenes, nucleophilic attack on carbenes, Simmons-Smith reaction, Reimer-Tiemann reaction, Carbylamine reaction, Shapiro reaction, Bamford-Stevens reaction and Wolff rearrangement

C) Nitrene: Generation, structure and reactions.

Unit II:

Stereochemistry: Elements of symmetry, Concept of chirality and molecular dissymmetry, molecules with more than one chiral center, meso compounds, threo and erythro isomers, method of resolution, optical purity, topicity of ligands, enantiotopic and distereotopic ligands and faces, prochirality, Cahn-Ingold-Prelog System to describe configuration at chiral centers**.** Inter conversion of Newman, Sawhorse and Fischer projection.

Conformational analysis of cycloalkanes (5-8 membered rings), substituted cyclohexanes, mono substituted, disubstituted and trisubstituted cyclohexanes, decalin system, effect of conformation on reactivity, Conformational analysis of *n*-butane and its derivatives, 1,2-diols, 1,2-dihaloethane and related compounds

Asymmetric synthesis, optical activity in absence of chiral carbon (biphenyl, spiranes and allenes), Chirality due to helical shape. Chirality of heteroatoms, stereospecific and stereoselective synthesis**.**

Unit III:

A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond**'**s postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and

intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases**.**

B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration.

C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation.

D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The *o*/*p* ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe–Schmitt reaction

Unit IV:

A) Aliphatic nucleophilic substitution: The S_N1, S_N2, mixed S_N1, S_N2 and SET and S_Ni mechanisms**.** Nucleophilicty, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction

B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen**.** Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude.

C**) Aromatic Nucleophilic Substitution:** A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, S_N1, benzyne and SRN1 mechanisms, arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions

Combined References of Organic Chemistry for Semester I and II:

1. Advanced Organic Chemistry –Reaction mechanism and structure, Jerry March, John Wiley
2. Advanced Organic Chemistry -F.A .Carey and R .J .Sunberg, Plenum
3. A Guidebook to Mechanism in Organic Chemistry-Peter Skyes, Longman
4. Structure and Mechanism in Organic Chemistry-C.K .Gold, Cornell University Press
5. Organic Chemistry, R.T .Morrison Boyd .Prentice Hall
6. Modern Organic Chemistry-H.O .House, Benjamin
7. Principal of Organic Chemistry-R.O.C .Norman and J. M. Coxon, Blackie Academic and Professional
8. Reaction Mechanism in Organic Chemistry-S.M .Mukharji and S.P .Singh, Macmilan
9. Stereochemistry of Organic Compounds -D .Nasipuri, New Age International
10. Stereochemistry of Organic Compounds -P .S .Kalsi, New Age International
11. Frontier Orbitals and Organic Chemical Reactions-I .Fleming

12. Orbital Symmetry –R .E .Lehr and A .P .Marchand
13. Reactive Intermediate in Organic Chemistry-N .S .Isaacs
14. Stereochemistry of Carbon Compounds -E .L .Eliel
15. Physical Organic Chemistry-J .Hine
16. Name Reaction in Organic chemistry –Surrey
17. Advanced Organic Chemistry –L .F .Fieser and M .Fieser .
18. Organic Chemistry Vol .I and II -I .L .Finar
19. Modern Organic Chemistry -J.D .Roberts and M .C .Caserio
20. The Search for Organic Reaction Pathways)Longmann(, Peter Skyes
21. Organic Chemistry 5th Edition)McGraw Hill(, S .H .Pine
22. Organic Chemistry)Willard Grant Press Botcon(, John Mcmurry
23. A Textbook of Organic Chemistry -R .K .Bansal New Age International
24. Organic Chemistry, J .Clayden, N .Greeves, S .Warren and P .Wothers, Oxford University Press
25. Organic Chemistry, 4th Edition, G Marc Loudon, Oxford University Press

Weblink to Equivalent MOOC on NPTEL/SWAYAM if relevant:

- Introductory Organic Chemistry I- https://nptel.ac.in/courses/104106119
- Mechanisms in Organic Chemistry- https://onlinecourses.nptel.ac.in/noc22_cy42
- Mechanisms in Organic Chemistry: https://onlinecourses.nptel.ac.in/noc20_cy26/preview
- Stereochemistry- https://nptel.ac.in/courses/104105086
- Stereochemistry and Applications- https://nptel.ac.in/courses/104106127
- Structure, Stereochemistry and Reactivity of Organic Compounds and Intermediates: A Problem-solving Approach- https://nptel.ac.in/courses/104105127

SEMESTER II

Paper 6

MCH2T06: Analytical Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course students will be able to-

1. *Select a specific analytical technique based on sample and target analyte*
2. *Develop analytical ability and critical thinking in selection of statistics and their use in making interpretation meaningful and productive.*
3. *Explain the logic behind working of indicator used in each type of titration*
4. *Elaborate interaction of radiation with matter and its application in chemical analysis.*
5. *Develop spectral methods of analysis for desired analytes.*
6. *Apply electroanalytical techniques based on conductance and emf measurements.*

Unit I:

Introduction to analytical chemistry: Types of analysis-qualitative and quantitative. Classification of analytical methods- classical and instrumental, basis of their classification with examples. Classification of analysis based on sample size (macro, semimicro, micro and ultramicro) and constituent type (major, minor, trace and ultratrace).

Volumetric Calculations: Stoichiometric and substoichiometric volumetric analysis. Concentration units: Unified atomic mass unit and the mole, Molarity, Normality, Weight and volume percent, Mole fraction, Formality, etc and their interrelation. Standard solutions. Primary standards and secondary standards. Numerical problems based on standard solution preparation, titrimetric analysis and gravimetric analysis. Calculations involved in acid-base, precipitation, redox and complexometric reactions.

Unit II: Classical methods of analysis

Volumetric analysis**:** General principle**.** Criteria for reactions used in titrationsTheory of indicators. Types of titrations with examples- Acid-base, precipitation, redox and complexometric. Titration curves for monoprotic and polyprotic acids and bases. Indicators used in various types of titrations. Masking and demasking agents.

Gravimetric analysis**:** General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibria. Steps involved in gravimetric analysis. Purity of precipitate: Co-precipitation and post-precipitation. Fractional precipitation. Precipitation from homogeneous solution. Particle size, crystal growth, colloidal state, aging and peptization phenomena. Ignition of precipitates.

Unit III: Optical methods of analysis-I

Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification and deviations. Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity

and analytical significance of molar extinction coefficient and λ_{max}. Comparison method, calibration curve method and standard addition method for quantitative estimation. Role of organic ligands in spectrophotometric analysis of metal ions. Ringbom plot and Sandell's sensitivity. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Composition and stability constant of complex by Job's and mole ratio methods. Derivative spectrophotometry. Numerical problems.

Flame photometry: Principle. Instrumentation and types of burners. Factors affecting flame photometric determination. Limitations of flame photometry. Interferences in flame photometry. Applications.

Unit IV: Electrochemical methods of analysis-I

Conductometry: Concepts of electrical resistance, conductance, resistivity and conductivity. Specific, molar and equivalent conductance and effect of dilution on them. Measurement of conductance. Kohlrausch's law, Applications of conductometry in determination of dissociation constant, solubility product. Conductometric titrations. High frequency titrations. Numerical problems.

Potentiometry: Circuit diagram of simple potentiometer. Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes: Calomel electrode and Ag/AgCl electrode. Theory of potentiometric titrations. Nernst equation, standard electrode potential, Determination of cell potential, n, K_f and K_{sp}. pH titrations. Buffers and buffer capacity. pH of buffer mixtures based on Henderson-Hasselbalch equation and calculations.

References

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Instrumental Methods of Analysis**:** Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons)
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
13. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
14. Fundamental of Analytical Chemistry: S. A. Skoog and D. W. West
15. Instrumental Methods of Chemical Analysis: G. W. Ewing
16. Polarography: Koltoff and Ligane
17. Electroanalytical Chemistry: Sane and Joshi (Quest Publications)

Web link for related NPTEL courses

Analytical Chemistry: https://nptel.ac.in/courses/104105084

SEMESTER II

Paper 7 (Elective)

MCH2T07: (a) Solid state and organometallic chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student would be able to

1. *Understand the structures of various types of solids.*
2. *Establish structure-property correlation in solids.*
3. *unravel and interpret the structural aspects of metal clusters.*
4. *Explain structures and applications of organotransition compounds,*
5. *predict the mechanism of complex reactions.*
6. *establish the thermodynamic and kinetic stability of reactants and products in complex reactions.*

Unit I

Solid State Chemistry: Ionic Crystals and their structures, radius ratio rule, effect of polarization on crystals. Covalent structure type: Sphalerite and Wurtzite. Geometry of simple crystal AB type: NaCl, CsCl and NiAs. AB_2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O, $CdCl_2$, CdI_2 structures. Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality and deviation structures $FeTiO_3$.

Solids of AB_2O_4 type: Normal and inverse,2-3 and 4-2 spinel, packing of oxygen in tetrahedral and octahedral sites, sites occupancy number of sites surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel. Hausmannite (Jahn-Teller distortions), Factors causing distortion in spinel.

Unit – II

(A) Metal – Ligand Bonding in Transition Metal Complexes: Recapulization of Crystal Field Theory, Application of CFT to Tetragonal, square-planer, Trigonal bipyramidal complexes, Jahn-Teller effect, Nephelauxetic effect, Limitations of crystal field theory.

(B) Magnetic Properties of Transition Metal complexes: Abnormal magnetic properties, orbital contributions and quenching of orbital angular momentum, spin-orbit coupling. Magnetic moment, electronic spectra and structure of tetrahalocobalt (II) complexes, tetrahedral and octahedral Ni(II) complexes. High spin-low spins crossover.

Unit III

Reaction mechanism of Transition Metal Complexes-II: Substitution reaction in square planar complexes: the trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect of temperature. Trans effect theories, uses of trans-effect, mechanism of substitution reactions in Pt(II) complexes. Electron transfer reactions. Types of electron transfer reactions, conditions of electron transfer, and mechanism of one-electron transfer reactions, outer sphere and inner sphere mechanisms, two electron transfer reactions complimentary and non-

complimentary reactions. Tunneling effect, cross-reaction, Marcus-Hush theory, bridged activated mechanism.

Unit-IV

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability and decomposition pathways of alkyls and aryls of transition metals. Organocopper in Organic synthesis. Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes and carbynes–synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on ligands, role inorganic synthesis.

References

1. J.E.Huheey: Inorganic Chemistry
2. F.A.Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th and 6th Editions.
3. A.F. Willims: Theoretical Approach in inorganic chemistry.
4. Mannas Chanda: Atomic Structure and chemical Bonding
5. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
6. J. J. Logowski: Modern Inorganic Chemistry
7. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
8. J C. Bailar: Chemistry of coordination compounds.
9. W. L. Jolly: Modern Inorganic ChemistryJones: Elementry Coordination chemistry.
10. B. N. Figgis: Introduction to Ligand field.
11. M.C.Day and J.Selbin: Therotical Inorganic Chemistry.
12. J. Lewin and Wilkins: Modern Co-ordination chemistry.
13. Purcell and Kotz: Inorganic Chemistry.
14. D. Banerjea: Co-ordination chemistry, Tata Mc. Graw. Pub.
15. A.F. Wells: Structural inorganic chemistry, 5th Edition, Oxford.
16. S. G. Davies: Organotransition metal chemistry applications to organic synthesis.
17. R. C. Mehrotra: Organometallic chemistry Tata McGraw Hill. Pub.
18. G. S. Manku: Thereotical priciples of inorganic chemistry
19. A. B. P. Lever: Inorganic electronic spectroscopy.
20. R.H.Crabtree:The Organometalic chemistry of Transition metals, John Wiley.
21. D.N.Styanaryan:Electronic Absorption Spectroscopy and related techniques, University Press.
22. R. S. Drago: Physical methods in inorganic chemistry
23. F.Basolo andG.Pearson: Inorganic Reaction Mechanism
24. Organometallics II and I complexes with transition metal- carbon bonds: Manfred Bochmann-
25. Oxford Press.
26. Advanced Inorganic Chemistry Vol I and II – Satyaprakash, Tuli, Bassu and Madan- S Chand.
27. A.E.Martel; Coordination Chemistry-VolIandII,VNR.

SEMESTER II

Paper 7 (Elective)

MCH2T07: (b) Organic Reaction Mechanism

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Predict the orientation and stereochemistry of the product of addition and elimination reaction*
2. *Apply enolate chemistry to achieve molecular complexity*
3. *Design organic reactions in order to achieve the required product(s)*
4. *Formulate green chemistry synthesis to increase atom economy*
5. *Application of free radicals in functional group transformation*

Unit-I

A) Addition to carbon-carbon multiple bond: Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry of common reactions, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration-oxidation, epoxidation, Michael addition

B) Elimination reactions: The E1, E2 and E1CB mechanisms, Stereochemistry of E2 elimination, Orientation of the double bond, Saytzeff and Hoffman's rule, Effect of substrate structure, attacking base, leaving group and medium, Mechanism and orientation in pyrolytic elimination involving selenium oxide, Cope and Chugaev elimination

Unit II:

Addition to carbon-hetero atom multiple bond: Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, keto-enol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, geometry of carbanions, kinetic and thermodynamic control in the generation of enolates, Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Wittig reaction, Mechanisms and synthetic applications of condensation reactions involving enolates- Aldol, Knoevengel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Robinson annulation, Hydrolysis of esters and amide, Baylis-Hillman reactions, Ugi and Passerini reaction.

Unit III:

Free radical reactions: Generation of free radicals, Type of free radical reactions, free radical substitution, mechanism at an aromatic and aliphatic substrate, reactivity at a bridgehead position. The reactivity and selectivity principle of halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation, chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Hunsdiecker reaction, Barton reaction, Hoffmann-Loefler-Freytag reaction, McMurry coupling, Samarium(II) iodide reagents for functional group transformations and C-C bond formation.

Applications of tributytin hydride: Reduction of halides, alcohols and acids, addition to carbon-carbon double bond, cyclization of free radical intermediates, tandem radical cyclization reactions, fragmentation reactions

Unit IV

Molecular rearrangements: Definition and classification. Mechanism, stereochemistry and synthetic applications of Pinacol-Pinacolone, Wagner- Meerwein, Tiffenev–Demjnov ring expansion, Arndt-Eistert synthesis, Dienone-phenol rearrangement, rearrangement due to electron deficient nitrogen: Hofmann, Lossen, Curtius, Schmidt and Beckmann rearrangements, Baeyer-Villiger oxidation, Dakin oxidation, [1,2]-Wittig rearrangement, Base catalysed rearrangements: Benzilic acid, Favourski, Neber, Sommlett-Hauser and Smiles rearrangement, Stevens rearrangement

Fragmentation reactions: Electron push and pull requirement, Beckmann fragmentation, Eschenmoser fragmentation, Alicyclic-Grobb rearrangement

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Weblink to Equivalent MOOC on SWAYAM if relevant:

- Essentials of Oxidation, Reduction and C-C Bond Formation. Application in Organic Synthesis- https://nptel.ac.in/courses/104101127
- Principles of Organic Synthesis- https://nptel.ac.in/courses/104103110
- Introductory Organic Chemistry II- https://onlinecourses.nptel.ac.in/noc21_cy46/preview

SEMESTER II

Paper 7 (Elective)

MCH2T07: (c) Quantum, Statistical and Nuclear Chemistry

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Understand, the concept of statistical thermodynamics and their uses.*
2. *Understand the quantum mechanical applications in actual practice and in spectroscopy*
3. *Understand the thermodynamics of real processes*
4. *Understand the distribution laws and their applications*
5. *Understand the fundamentals of Nuclear sciences*

UNIT I: QUANTUM MECHANICS - II

Approximate methods, variation principle, its application in Linear and non-linear functions, MO theory applied to H_2^+ molecule and H_2 molecule (calculation of energy), Introduction to perturbation theory (First order correction to wave function and energy), Application to He atom.

Electronic structure of atoms: Russel Sanders terms and coupling schemes, term separation energies of the p^n configuration, term separation energies for d^n configuration, magnetic effects: spin orbit coupling and Zeeman splitting.

Hybridization, hybrid orbitals in terms of wave functions of s and p orbitals, sp and sp^2 hybridizations, Simple Hückel theory applied to: ethylene, butadiene and cyclobutadiene.

UNIT II :STATISTICAL THERMODYNAMICS

Statistical thermodynamics :Lagrange's Method of Undetermined Multipliers)Conditional Maximization(, Stirling Approximation, Concept of Distribution, Thermodynamic Probability and most probable distribution, Maxwell Boltzmann, Bose Einestein, Fermi Dirac statistics, comparison between three statistics.

Partition function, Translational partition function, Rotational partition function, Vibrational partition function, Electronic partition function, Applications of partition functions, Numerical.

UNIT III :STATISTICAL MECHANICS OF ENSEMBLES AND NON-EQUILIBRIUM THERMODYNAMICS

Atomic and Molecular quantum levels, Significance of Boltzmann Distribution law, partition Functions and ensembles, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro canonical ensembles, corresponding distribution laws using Lagranges method of undetermined multipliers. Ortho and para hydrogen, principle of equipartition of energy, calculation of average energy.

Nonequilibrium Thermodynamics :Conservation of mass and energy in time dependent closed and open systems, Thermodynamic criteria of irreversibility, rate of entropy production and entropy exchange in irreversible processes .The generation of the concept of Chemical Affinity and the extent of

advancement of chemical reactions, Thermodynamic constraints on the signs of chemical affinity and the velocity of chemical reaction, application to any one coupled reaction.

UNIT IV :NUCLEAR CHEMISTRY

Introduction, radioactive decay and equilibrium, thermonuclear reactions, photonuclear reactions, Radiometric titration, isotopic dilution analysis, NAA.

Nuclear models: Fermi gas model, shell model, liquid drop model, application of liquid drop models semiempirical mass equation.

Counters: proportional counter, GM counter, scintillation counter, ionization chamber counter.

References

1) Ira N .Levine, Quantum Chemistry, 5th edition)2000(, Pearson educ., Inc.New Delhi
2) A. K. Chandra, Introductory Quantum Chemistry, 4th edition)1994(, Tata Mc-graw Hill, New Delhi.
3) M.W. Hanna, "Quantum Mechanics in Chemistry", Benjamin
4) L .Pualing and E .B .Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York)1935.(
5) R .K .Prasad, Quantum Chemistry, New Age International, Delhi .
6) R .K .Prasad, Quantum Chemistry through problems and solutions, New Age International, New Delhi, 2009.
7) B .C .Reed, Quantum Mechanics, Jones and Bartlett, New Delhi, 2010.
8) R .P .Rastogi and R .R .Mishra, An Introduction to Chemical Thermodynamics, Vikas Publication, Gorakhpur, 2010.
9) P .W .Atkins'and D .Paula, Physical Chemistry, 8th Edition, Oxford University Press, 2010.
10) G .K .Vemulapalli, Physical Chemistry, Prentice –Hall of India, 1997.
11) S .Glasstone, An Introduction to Electrochemistry, East-West Press Pvt .Ltd., New Delhi, 2004.
12) H .K .Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
13) S .O .Pillai, Solid State Physics, New Age International, New Delhi, 2102.
14) N .B .Hanny, Treaties in Solid State Chemistry,
15) M .C .Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub .Corp., New York,
16) I Prigogine and R .Defay, Chemical Thermodynamics, Longmans, London, 1954.
17) S .R .DeGroot and P .Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam, 1969.
18) G .Lebon, D .Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer, 2008.
19) I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes, "Wiley-Interscience.
20) R .P .Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
21) G .A .Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.

22) M .C .Gupta, Statistical Thermodynamics, New Age International.
23) K .Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
24) Andrew Maczek, Statistical Thermodynamics, Oxford University Press Inc., New York)1998.(
25) C.N. Rao .Nuclear Chemistry
26) B .G .Harvey, Introduction to Nuclear Physics and Chemistry, Prentice Hall, Inc) .1969.(
27) H.J .Arnikar, Essentials of Nuclear Chemistry, 4th Edition)1995(, Wiely-Eastern Ltd., New Delhi.
28) L .E .Smart and E .A .Moore, Solid State Chemistry-An Introduction, CRC Tylor and Fransis, 2005.
29) D .D .Sood, A .V .R .Reddy, Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, 2007.
30) C .N .R .Rao and Gopalakrishnan, "New Directions in Solid State Chemistry" Second Edition, Cambridge University Press.
31) Anthony R .West, "Solid State Chemistry and its Applications "Wiley India Edition.
32) C .Kalidas and M .V .Sangaranarayana, Non-Equilibrium Thermodynamics.

NPTEL sources weblinks:

- Quantum Chemistry: https://archive.nptel.ac.in/courses/104/105/104105128/
- https://www.youtube.com/watch?v=InNx7cYE9DI
- https://onlinecourses.nptel.ac.in/noc22_cy02/preview
- For statistical Thermodynamics: https://onlinecourses.nptel.ac.in/noc23_me69/preview
- https://nptel.ac.in/courses/104103112
- For Nuclear Chemistry: https://onlinecourses.nptel.ac.in/noc23_cy21/preview
- https://www.youtube.com/watch?v=iMhDYarsfII
- https://archive.nptel.ac.in/courses/112/103/112103243/

SEMESTER II

Paper 7 (Elective)

MCH2T07: (d) Instrumental Methods of Analysis

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course students will be able to -

1. *Understand the importance of sampling and sample treatment.*
2. *Select appropriate sampling technique based on sample and target analyte.*
3. *Explain principle and instrumentation involved in AAS.*
4. *Deduce the necessity to remove interferences in AAS and methods involved .*
5. *Select proper technique among the available techniques.*
6. *Formulate experiments based on optical and electroanalytical techniques.*

Unit-I:

Sampling and sample treatment: Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples.

Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.

Unit-II: ***Atomic absorption spectroscopy***

Principle**.** Atomic energy levels**.** Grotrian diagrams**.** Population of energy levels**.** Instrumentation**.** Sources**:** Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width**.** Atomizers**:** Flame atomizers, graphite rod and graphite furnace**.** Cold vapour and hydride generation techniques**.** Factors affecting atomization efficiency, flame profile**.** Monochromators and detectors**.** Beam modulation**.** Detection limit and sensitivity**.** Interferences and their removal**.** Comparison of AAS and flame emission spectrometry**.** Applications of AAS**.**

Unit-III: Polarography and amperometry

Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and

speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.

Amperometric titrations: Principle, types and applications in analytical chemistry.

Unit-IV: Miscellaneous techniques

Fluorometry and phosphorimetry: Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications.

Nephelometry and turbidimetry: Principle, instrumentation and applications.

Photoacoustic spectroscopy: Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

References

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Instrumental Methods of Analysis**:** Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons)
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
13. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
14. Fundamental of Analytical Chemistry: S. A. Skoog and D. W. West
15. Instrumental Methods of Chemical Analysis: G. W. Ewing
16. Polarography: Koltoff and Ligane
17. Electroanalytical Chemistry: Sane and Joshi (Quest Publications)

Web link for related NPTEL courses

- Analytical Chemistry: https://nptel.ac.in/courses/104105084

SEMESTER II

Practical 3

MCH2P03: On Job Training/Field Project

120 h (8 h per week) *100 Marks*

On job training or a Field Project is a skill based practical program. It has to be carried out in accordance

Annexure III of General Guidelines for M.Sc. program.

1. Every student admitted to M.Sc. Second Semester is compulsorily required to undergo this course bearing 4 credits.
2. During second semester, all students will have to undergo OJT/Internship/FP of 120 Hours.
3. Each student will be required to submit a detailed report to the Department/ College/ Institute for the work undertaken during this period **within 7 days of completion of the training** following which the evaluation and assessment for OJT/Internship/FP will be done by the college/institute concerned. The Report submitted must be according to the Learning outcomes and in tune with the rubric for evaluation.
4. College/Institute is required to assign Supervisor/Mentor to students for OJT/Internship/FP who will guide the students in attaining the outcomes of this course.
5. The Internal Examiner and External Examiner shall jointly evaluate the report submitted by the student and her/his seminar and shall immediately submit the evaluation report in the prescribed format provided along with.

SEMESTER II

Practical 4

MCH2P04: Organic Chemistry

6 h per week *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Handling of the hazardous chemicals by safely*
2. *Predict and analysis of the major and minor products of a variety of organic reactions*
3. *Monitoring of the chemical reactions*
4. *Calculation of yield, percentage yield of the chemical reactions*
5. *Understand the concept of Qualitative analysis*

a. **Organic preparations:** Student is expected to carry out minimum of 7-10 single stage preparation and 3-4 two stage organic preparation from the following lists (**Total 10 preparations**). During preparation of organic compounds, the techniques such as crystallization, distillation, solvent extraction, TLC and column chromatography should be demonstrated.

2. Oxidation :Adipic acid by chromic acid oxidation of cyclohexanol.
3. Benzophenone → benzhydrol
4. Aldol condensation :Dibenzal acetone from benzaldehyde .
5. Sandmeyer reaction :p -chlorotoluene from p-toluidine
6. Cannizzaro reaction
7. Friedel Crafts Reaction :β-Benzoyl propionic acid from succinic anhydride and benzene.
8. Benzoin → 2,4,5-triphenyl imidizole
9. Sucrose → Oxalic acid
10. Methyl acetoacetate → 5-methyl-isoxazol-3-ol
11. Ethyl acetoacetate → 4-aryl-6-methyl-3,4-dihydro-2)1*H*-(pyrimidinone ester
12. Ethyl acetoacetate → Diethyl 1,4-dihydro-2,6-dimethyl-4-phenylpyridine-3,5-dicarboxylate
13. Dye preparation :Sulphanilic acid → Methyl orange
14. Dye preparation :p-nitroaniline → *p*-red
15. Acetanilide → *p*-nitroacetanilide →*p*-nitroaniline
16. Aniline → 2,4,6-tribromo aniline → 2,4,6-tribromoacetanilide
17. Nitrobenzene →m-dinitrobenzene →*m*-nitroaniline
18. toluene → *p*-nitrotoluene →*p*-nitrobenzoic acid
19. Glycine → Benzoyl glycine → 4-benzilidene-2-phenyl oxazole
20. Benzaldehyde → chalcone → chalcone dibromide
21. *Any other suitable preparation of organic molecules depending on availability of chemicals*

B) Qualitative Analysis : Separation, purification and identification of the mixture of two organic compounds)binary mixture with two solid, one solid one liquid and two liquids (using chemical methods or physical techniques. **Minimum 6-10 mixtures to be analyzed**.

References

1) Practical organic chemistry by FG Mann and BC Saunders
2) Text book of practical organic chemistry –by Vogel
3) The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin
4) Compendious Practical Organic Chemistry : Preparations, Isolation, and Chromatography by Basavarajaiah S M, Nagesh G Y, Ramakrishna Reddy K
5) Advanced Practical organic chemistry by N.K.Vishnoi

SEMESTER II

Practical 5

MCH2P05: Analytical Chemistry

6 h per week *100 Marks*

Course Outcomes: *At the end of the course, student will be able to*

1. *Carry out calibration of glassware available in the laboratory.*
2. *Analyze the data obtained through experiments using statistical analysis parameters.*
3. *Estimate quantitatively analyte present in different samples using classical and instrumental methods of analysis.*
4. *Design experiments based on classical and instrumental techniques.*
5. *Understand the principles involved in visual and instrumental volumetric techniques.*
6. *Formulate experiments based on optical and electroanalytical techniques.*

Section (A): Classical methods and separation techniques:

Calibration, validation and computers

1. Calibration of pipette and burette.
2. Statistical analysis of data.
3. Use of MS-Excel in statistical analysis of data and curve fitting.

Volumetry

1. Determination of Na_2CO_3 in washing soda.
2. Determination of NaOH and Na_2CO_3 in a mixture.
3. Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
4. Estimation of nickel in given solution by complexometric back-titration with EDTA.
5. Estimation of chloride in given solution by Mohr's titration.
6. Estimation of chloride in given solution by Volhard's titration.
7. Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
8. Estimation of phenol/ aniline by bromination method.
9. Estimation of glucose.
10. Estimation of acetone.
11. Estimation of formaldehyde.
12. Estimation of Mn in the presence of Fe using masking phenomenon (ferromanganese alloy).

Gravimetry

1. Estimation of barium as barium sulphate.
2. Estimation of calcium as calcium oxalate/ calcium carbonate/ calcium oxide.

Separation techniques

1. Qualitative separation of metal ions by paper chromatography for 2/3 components.
2. Determination of ion-exchange capacity of resin.
3. Separation of ions by ion exchange.

Section (B): Instrumental techniques: Electroanalytical techniques

1. Analysis of commercial vinegar by conductometric titration.
2. Estimation of phenol by conductometric titration with NaOH.
3. Determination of strength of HCl and CH_3COOH in a mixture conductometrically.
4. Determination of strength of HCl and oxalic acid in a mixture conductometrically.
5. Determination of strength of oxalic acid and CH_3COOH in a mixture conductometrically.
6. Determination of degree of dissociation and dissociation constant of acetic acid conductometrically.
7. Estimation of phenol in dilute solution by conductometric titration with NaOH.
8. Determination of strength of HCl and CH_3COOH individually and in a mixture potentiometrically.
9. Determination of Fe(II) by potentiometric titration with $K_2Cr_2O_7$.
10. Determination of three dissociation constants of H_3PO_4 by pH-metric/ potentiometric titration.

Optical methods

1. Determination of pK of indicator by colorimetry.
2. To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
3. To study the complex formation between Fe(III) and salicylic acid and find the formula and stability constant of the complex colorimetrically (Job's method).
4. To determine the dissociation constant of phenolphthalein colorimetrically.
5. Estimation of iron in wastewater sample using 1,10-phenanthroline.

References

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Experiments and calculations in Engineering Chemistry- S. S. Dara (S. Chand and Co.)
5. Experiments in Chemistry-D. V. Jahagirdar (Himalaya)

SEMESTER III

Paper 8

MCH3T08**: Spectroscopy-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course, student will be able to*

1. *Understand the symmetry properties of molecules*
2. *Interpret the structure of simple organic molecules using mass spectrometry*
3. *Correlate the presence of functional groups with IR frequencies*
4. *Apply the IR and Raman spectroscopy to simple molecules*

Unit - I: Symmetry properties of molecules and group theory:

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C_{2v}, C_{3v} and C_{2h}. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H_2O and NH_3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II:

A] **Mass spectrometry:** Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, Nitrogen-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, McLafferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry, problem based on mass spectral data

B] **Mössbauer spectroscopy**: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction, applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit - III:

A] **Microwave spectroscopy**: Classification of molecules on the basis of M.I., rigid and non-rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B] **ESR spectroscopy**: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4-semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV:

A] Infrared spectroscopy: Diatomic molecules: Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy, problem based on IR spectral data

B] Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent anti-Stokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

References

1. Spectroscopic identification of organic compound-RM Silverstein, GC Bassler and TC Morril, John Wiley
2. Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiley
3. Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4. Organic Spectroscopy-William Kemp, ELBS with McMillan
5. Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6. Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
7. Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
8. Fundamentals of Molecular Spectroscopy-CN Banwell
9. Spectroscopy in Inorganic Chemistry-CNR Rao and JR Ferraro
10. Photoelectron Spectroscopy-Baber and Betteridge
11. Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
12. NMR –Basic Principle and Application-H Guntur
13. Interpretation of NMR spectra-Roy H Bible
14. Interpretation of IR spectra-NB Coulthop
15. Electron Spin Resonance Theory and Applications-W Gordy
16. Mass Spectrometry Organic Chemical Applications, JH Banyon

SEMESTER III

Paper 9

MCH3T09**: Advanced Organic Chemistry-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Identify a pericyclic reaction and categorize it as a cycloaddition, a group transfer reaction, a sigmatropic rearrangement, or an electrocyclic reaction,*
2. *Apply frontier molecular orbital (FMO) theory to rationalize selectivity and reactivity aspects of pericyclic reactions.*
3. *Understand the reaction mechanism of various common reagents employed in organic synthesis*
4. *Understand the reactivity of sulphur, silicon and phosphorous elements.*
5. *Apply pericyclic reactions for the synthesis of complex organic molecules*

Unit I: Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of Molecular Orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion for 4n and (4n+2) systems, Cycloaddition reaction with more emphasis on [2+2] and [4+2], Cycloaddition of ketenes, Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and inversion of configuration, [3,3] and [5,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction

Unit II: Oxidation

Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil, Oxidation with SeO_2, Epoxidation of olefins, application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis, Etard Reaction

Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS, SO_3 and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation, CAN, Tetrapropyl ammonium peruthenate, Fetizon's reagent, Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periodane, IBX and related hypervalent iodine based oxidations

Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation, Dakin oxidation, Tamao-Fleming Oxidation, Oxidations with Dimethyl dioxirane (DMDO) and 2-sulfonyloxaziridines and chiral version

Unit III: Reduction

Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst

Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis

Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV: Chemistry of P, S, Si, and Boron compounds

1) Phosphours and sulphur ylide: Preparation and their synthetic application along with stereochemistry

2) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, *bis*-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiaminehydrochloride based generation of acyl anion

3) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexylborane, cyclohexylborane, $ICPBH_2$, IPC_2BH, Hydrboration mechanism, stereo and regioselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis of *EE, EZ, ZZ* dienes and alkyenes. Mechanism of addition of IPC_2BH. Allylboranes-synthesis, mechanism and uses

4) Organosilicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Peterson reaction, Synthesis and reactions of alkenyl, alkynyl and aryl silanes

References

1. Organic Chemistry, J .Clayden, N .Greeves, S .Warren and P .Wothers, Oxford University Press
2. Some Modern Methods of Organic Synthesis-W .Carruthers
3. Principles of Organic Synthesis by R. O. C. Norman and James M. Coxon (Nelson Thornes Ltd)
4. Advance Organic Chemistry Part-B-F .A .Caray and R .J .Sundberg Plenum Press
5. Modern Organic Synthesis: An Introduction by G. S. Zweifel and M. H. Nantz (Wiley)
6. Organic Synthesis by Michael Smith , 4th Edition (Academic Press)
7. Pericyclic Reactions by I. Fleming, Oxford University Press, 1999
8. S. Sankararaman, Pericyclic Reactions – A textbook. Wiley-VCH, 2005.
9. Organic synthesis: The roles of boron and silicon by S. E. Thomas (Oxford Chemistry Primers)
10. The Chemistry of Organophosphorous-A .J .Kirbi and S.G .Warren
11. Organosilicon Compound-C .Eabon
12. Organic Synthesis via Bora- H. C. Brown
13. Organoborane Chemistry-T .P .Onak
14. Organic Chemistry of Boron-W Gerrard

Weblink to Equivalent MOOC on SWAYAM if relevant:

- Organic Photochemistry and Pericyclic Reactions: Dr. N.D. Pradeep Singh Department of Chemistry IIT Kharagpur, https://nptel.ac.in/courses/104105038
- Pericyclic Reactions and Organic Photochemistry: Prof. Sankararaman, IIT Madras https://nptel.ac.in/courses/104/106/104106077/
- Essentials of Oxidation, Reduction and C-C Bond Formation. Application in Organic Synthesis https://nptel.ac.in/courses/104/101/104101127/
- Reagents in organic synthesis: Prof. Subhas C. Pan, IIT Guwahati https://archive.nptel.ac.in/courses/104/103/104103111/
- Principles of Organic Synthesis: Prof. T. Punniyamurthy, IIT Guwahati, https://archive.nptel.ac.in/courses/104/103/104103110/

SEMESTER III

Paper 10

MCH3T10**: Advanced Inorganic Chemistry**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Understand the crystal structures of simple inorganic molecules.*
2. *Understand the industrial applications of catalysis.*
3. *Apply the mechanism of metallo-enzyme actions in various life processes.*
4. *Apply simple methods of synthesis and characterization to nanomaterials.*

Unit I: Solid State Chemistry

Ionic Crystals and their structures, radius ratio rule, effect of polarization on crystals. Covalent structure type: Sphalerite and Wurtzite. Geometry of simple crystal AB type: NaCl, CsCl and NiAs. AB_2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O, $CdCl_2$, CdI_2 structures.

Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality and deviation structures $FeTiO_3$.

Solids of AB_2O_4 type: Normal and inverse,2-3 and 4-2 spinel, packing of oxygen in tetrahedral and octahedral sites, sites occupancy number of sites surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel. Hausmannite (Jahn-Teller distortions), Factors causing distortion in spinel.

Unit II: Organometallic Chemistry

Introduction of Organometallic Chemistry, counting of electrons, 16-18 rule, Ligand substitution reactions, Oxidative Addition: Concerted, S_N2 and radical mechanism, Reductive elimination, Migratory insertion and elimination reactions, Migration and insertion reactions Alpha-Migratory insertion and Alpha-Elimination Reactions, beta-migratory insertion, Beta-Elimination Reaction, Alpha-Abstraction and Beta-Abstraction, 4-Center Reactions [2+2] Reactions, External Attack by a Ligand and Reductive Coupling

Hydrogenation Reaction [mobohydride and dihydride catalyst] Stereoselective hydrogenation reaction, Wilkinson catalyst, Schrock-Osborn catalysts for hydrogenation, Carbonylation Reaction: Monsanto Acetic Acid Process, Hydroformylation, Hydrocarboxylation and Hydrocyanation, Ziegler-Natta polymerization

Palladium catalyzed cross-coupling reactions-Heck reaction, carbonylation, Wacker oxidation, Kumada, Stille, Sonogashira, Negishi and Suzuki coupling reactions and their importance, Applications of $Co_2(CO)_8$**,** $Ni(CO)_4$, $Fe(CO)_5$ and in organic synthesis. Transition metal carbenes, Fischer and Schrock carbenes, Olefin metathesis by I^{st} and II^{nd} generation catalyst, Schrock and Grubbs catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, application in the synthesis of homo and heterocyclic compounds, polymerization and synthesis of small organic molecules.

Unit -III

A) Metallo enzymes: The principle involved and role of various metals in i) Zn-enzyme: Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme: Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme: Super Oxide dismutase iv) Molybdenum: Oxatransferase enzymes, Xanthine oxidase, Co-enzyme vitamin B_{12}, Structure of vitamin B_{12}. Co-C bond cleavage, Mutase activity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin.

B) Electron transfer in biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes and Fe-S proteins, non-heme iron proteins; Rubredoxins, Synthetic models. Biological nitrogen fixation (*in-vitro* and *in-vivo*).

Unit-IV: Nanomaterials and Microscopic Techniques

A) Nanoparticles and nanostructure materials: Introduction, methods of synthesis: conventional and biogenic synthesis. Molecular Precursor routes to inorganic solids: Nanoporous Materials: Zeolites, metal oxides, composites & molecular sieves, composition-structure, preparation & applications.

B) Carbon-based nanomaterials: Introduction, synthesis methods: CNT, graphene-based materials, graphitic carbon nitride, quantum dot, carbon dot.

C) Techniques for nanomaterials authentication: X-Ray diffraction, Fourier Transform Infrared Spectroscopy, UV-Diffuse Reflectance Spectroscopy, X-ray Photoelectron Spectroscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Energy Dispersive X-Ray Analysis, Brunauer-Emmett-Teller analysis, Thermogravimetric Analysis.

References

1. Inorganic Chemistry, Third Edition, Shriver and Atkins, Oxford University Press.
2. Inorganic Chemistry, Fourth Edition, Catherine E. Housecroft and Alan G. Sharpe, Pearson, England.
3. Principles of Inorganic Chemistry, thirty third edition, B. R. Puri, L. R. Sharma, K. C. Kalia, Milestone Publisher & Disruptors, Delhi.
4. Organometallic Chemistry, Revised Second Edition, R. C. Mehrotra, A. Singh, New Age International Publication, New Delhi.
5. Basic Inorganic Chemistry, Third Edition, F. Albert Cotton, Geoffrey Wilkinson, John Wiley & Sons Inc.
6. Essentials of Bio-Inorganic Chemistry, Neerja Gupta, Monal Singh, Pragati Edition, Meerut.
7. Inorganic Chemistry, Gary L. Miessler and Donald A. Tarr, Pearson Education International, New York.
8. Inorganic Chemistry, Fourth Edition, James E. Huheey, Ellen A. Keitler, Richard L. Keitler, Pearson Education International, New York.

9. Emerging Nanomaterials and Their Impact on Society in the 21st century, N. B. Singh, Md. A.B. Hasan Susan, R.G. Chaudhary, Material Research Forum, Millerville, USA.
10. Concept and Models of Inorganic Chemistry, Third Edition, B. Douglas, D. McDaniel, J. Alexander, John Wiley & Sons Inc., New York.
11. Inorganic Chemistry, K. F. Purcell, J. C. Kotz, Cengage Learning, Delhi.
12. Nanoscale Materials in Chemistry, K. I. Kalbunde, John Wiley, New York.
13. Biogenic Sustainable Nanotechnology, R. P. Singh, A. R. Rai, A. Abdala, R. G. Chaudhary, Elsevier, Amsterdam, Netherland.
14. Introduction To Nanoscience and Nanotechnology, Chris Binns, John Wiley & Sons Inc., New York.
15. Carbon nanomaterials: synthesis, structure, properties and applications, R. Mathur, B. Singh, S. Pande, Taylor & Francis, Boca Raton.
16. Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques, and Applications, R. K. Goyal, Taylor & Francis, Boca Raton.

SEMESTER III

Paper 11

MCH3T11**: Elective (a) Inorganic Chemistry Special-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course, student would be able to*

1. *Understand structure and bonding in transition metal pi complexes*
2. *Elaborate advance materials including supramolecules and advanced nanomaterials.*
3. *Classify and characterize the coordination polymers*
4. *Understand mechanism of photophysical and photochemical processes*
5. *Explain various redox processes in complexes.*

Unit-I

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics and synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene and trienyl complexes. Application of transition metal, organometallic intermediates in organic synthesis relating to nucleophilic and electrophilic attack on ligands, role in organic synthesis.

Unit-II

A) Supramolecular chemistry: Definition, intermolecular bonds, concepts and perspectives, cationic recognition, anionic recognition, neural molecular recognition: self-assembly concept and its application in molecular and supramolecular chemistry, supra molecular chemistry, supramolecular devices and machines.

B) Inorganic pharmaceuticals: Lithium drugs, gold antiarithritic drugs, Bismuth drugs in the treatment of gastric ulcers, Cyclams as anti-HIV agents, Radio-diagnostic agents, contrast agents for MRI and X-ray imaging.

C) Nano structural materials: Nanofibres, MXenes (two-dimensional inorganic compounds), Molecular Precursor routes to Nanoporous Materials: Zeolites and molecular sieves, porous lamellar solids, composition-structure, preparation and applications.

Unit-III

A) **Coordination Polymers**: Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B) **Characterization of coordination polymers on the basis of**:

i) Spectra (UV, Visible, IR and NMR)

ii) Magnetic and thermal (TGA, DTA and DSC) studies

Unit-IV

A] Photophysical and photochemical properties of Gold(I) complexes: Introduction, Binuclear and trinuclear complexes, Mixed metal Systems, Photochemical reactivity, Solid state studies, Mononuclear Gold(I) complexes, Mononuclear three coordinate Gold(I) complexes

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction and strong interaction – exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2- bipyridine and 1,10-Phenanthroline complexes.), illustration of reducing and oxidizing character of ruthenium(II); role of spin-orbit coupling, lie time of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to high energy products, chemical energy in to light.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, methods for obtaining charge transfer spectra.

References

1. Anderson J.C.,LeverK.D.,Alexander J.M and Rawlings,R.D.,ELBS
2. GrayG.W.Ed.Thermotropic Liquid Crystals,John Wiley
3. Kelkar and Hatz Handbook of Liquid Crystals,ChemieVerlag.
4. Kalbunde K.I.,Nanoscale Materials in Chemistry,JohnWiley,NY.
5. Shull R.D.,McMichael R.D. and SwartzendrubL.J.,Studies of Magnetic Properties of Fine particles and their relevance to Mataerials Science, Elsevier Pub. Amsterdam
6. Optoelectronic Properties of Inorganic Compounds, D. Max Roundhill and John P. Fakler, Jr. Plenum Press, New York

SEMESTER III

Paper 11

MCH3T11**: Elective (b) Organic Chemistry Special-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Learn the important aspects of steroids and terpenoids.*
2. *Understand the biosynthesis of natural products.*
3. *Analyze the enzyme reactions involved in various life processes*
4. *Illustrate the structure elucidation of unknown naturally occurring organic compound*
5. *Apply the knowledge of organic reactions for the total synthesis of useful natural products*

Unit I

A) Terpenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A.

B) Genesis of biological isoprene unit, Biosynthesis (**ONLY**) of the following tepenoids: myrecene, linalool, geraniol, α-terpeneol, limonene, camphor, α-pinene, β-pinene, farnesol, β-bisabolene and squalene.

Unit- II

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, generalmethods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring,role of alkaloids in plants Structure, stereochemistry, and total synthesis of the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine.

Biosynthesis (**ONLY**) of the followings: hygrine, tropinone, nicotine, pelletierine, conine.

Unit-III

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and total synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone. Biosynthesis of steroids (lanosterol)

Unit IV

A) Plant Pigments: Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and The Shikimate pathway: Biosynthesis of Cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids.

B) Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2 (E. J. Corey and Gilbert Stork synthesis only) and iodolactonization reaction.

References

1. Organic Chemistry Vol. II - I. L. Finar
2. Chemistry of Plant Natural Products: Sunil Kumar Talapatra and B. Talapatra (Springer)
3. Classical Methods in Structure Elucidation of Natural Products: *R. W. Hoffmann*, Wiley-VCH
4. A Fragrant Introduction to Terpenoid Chemistry: Charles S Sell (RSC)
5. Chemistry of Alkloids-S .W .Pelletier
6. Chemistry of Steroids-L .F .Fisher and M .Fisher
7. The Molecules of Nature-J .B .Hendricsion
8. Biogenesis of Natural Compound -Benfield
9. Natural Product Chemistry and Biological Significance -J .Mann, R .S Devison, J .B .Hobbs, D .V .Banthripde and J .B .Horborne
10. Introduction to Flavonoids-B .A .Bohm, Harwood
11. Chemistry of Naturally Occurring Quinines-R .H .Thomson
12. The Systematic Identification of Flavonoids -Marby, Markham, and Thomos

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Weblink to Equivalent MOOC on SWAYAM if relevant:

- Classics in total synthesis: Prof. Krishna P. Kaliappan, IIT Bombay (Useful for total synthesis of alkaloids, steroids and prostaglandins) https://archive.nptel.ac.in/courses/104/101/104101133/

SEMESTER III

Paper 11

MCH3T11**: Elective (c) Physical Chemistry Special-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Understand, the concept of statistical function, and applications*
2. *Understand the applications of electrochemistry in various fields*
3. *Understand the theories of advanced chemical dynamics*
4. *Understand the various photophysical processes and their applications*

UNIT I: ELECTRICAL AND THERMAL PROPERTIES OF SOLIDS

A**)** Classical free electron theory, electrical conductivity, thermal conductivity, Wiedemann-Franz Law, Lorenz number, Electronic distribution in solids using Fermi Dirac Statistics, The Fermi Distribution function and effect of temperature, Quantum theory of free electrons, periodic potential, The Kronig-Penney Model, Brillouin Zones, Distinction between metals, insulators and intrinsic semiconductors based on above theory**.**

B**)** Thermal Properties**:** Specific heat of solids, Classical theory, Einstein**'**s theory of heat capacities, Debye theory of heat capacities or Debye T-cubed law.

UNIT II: ELECTROCHEMISTRY OF SOLUTION

A**)** OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer: Helmholtz-Perrin, Gouy Chapman model, Stern region, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models**.**

B**)** Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C**)** Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve**.** Electro-osmosis, electrophoreses**.** Streaming and Sedimentation potentials**.** Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential**.**

UNIT III: CHEMICAL DYNAMICS - I

A**)** Dynamics of complex reactions**:** reversible, parallel, consecutive, concurrent and branching reactions, free radical and chain reactions, reaction between Hydrogen – Bromine and Hydrogen – Chlorine **(**thermal and photochemical**)**, decomposition of ethane, acetaldehyde, N_2O_5, Rice Herzfeld mechanism, Oscillatory autocatalytic and Belousov-Zhabotinsky reactions, Lotka-Volterra mechanism, the brusselator and the oregonator**.**

B**)** **Fast Reactions:** relaxation methods, flow methods, flash photolysis, magnetic resonance method, relaxation time and numerical**.**

UNIT IV: PHOTOCHEMISTRY

A**)** **Photophysical phenomenon:** Introduction, photo and photochemical excitation and de-excitation, fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching**:** concentration

quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern-Volmer equation.

B) **Photochemical reactions:** photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosensitization, chemiluminescence, photochemistry of environment: Greenhouse effect.

References

1. G. M. Panchenkov and V. P. Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, "Chemical Kinetics and Kinetics of Solutions", Academic
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4. J. Raja Ram and J. C. Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
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6. K. K. Rohtagi-Mukherjee, Fundamentals of Photochemistry, New Age International, New Delhi(1986).
7. R. P. Wayne, Principles and Applications of Photochemistry, Oxford University Press, Oxford(1988).
8. N. J. Turro, Modern Molecular Photochemistry, Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, Principles of Fluorescence Spectroscopy, 2nd Edition (1999), PlenumPublishers, NewYork.
10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics". AddisonWesley
11. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
12. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
13. N. J. Turro, V. Ramamurthy and J. C. Scaiano, Principles of Photochemistry – An Introduction, Viva Books, New Delhi, 2015.
14. G. A. Somorjai, Introduction to Surface Chemistry and Catalysis, Wiley, 2010.
15. M. C. Gupta, Statistical Thermodynamics, New Age International.
16. K. Huang, Statistical Mechanics, Wiley, New Delhi, 2003.
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19. D. A. McQuarrie, Statistical mechanics, Harper and Row Publishers, New York (1976).
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21. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi.
22. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
23. D. R. Crow, " The Principle of electrochemistry", Chapman Hall
24. G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill Pvt., Ltd. 1990

25. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.
26. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.

NPTEL sources weblinks:

- Electrochemistry of solutions: https://archive.nptel.ac.in/courses/104/106/104106129/
- Chemical Dynamics https://nptel.ac.in/courses/104101128
- https://onlinecourses.nptel.ac.in/noc20_cy22/preview
- https://nsdl.niscpr.res.in/bitstream/123456789/251/1/Photochemistry%20revised.pdf

SEMESTER III

Paper 11

MCH3T11**: Elective (d) Analytical Chemistry Special-I**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student will be able to

1. *Explain the principles involved in radiation chemistry.*
2. *Compare various detectors used in radiochemistry and select among them for desired analysis.*
3. *Compare various voltammetric techniques for given type of analysis.*
4. *Understand the electrodes used in different voltammetric techniques and their comparison.*
5. *Design experiments for water quality assessment based on parameter under study.*

Unit-I: Radioanalytical Chemistry

Radioactivity, Law of radioactive decay, Half life and mean life, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer, Ionization chamber, HPGe detector, NaI(Tl) detector**.** Preparation of some commonly used radioisotopes (^{22}Na, ^{60}Co, ^{131}I, ^{65}Zn, ^{32}P)**,** Use of radioactive isotopes in analytical and physico-chemical problems, Neutron Activation Analysis, Isotope Dilution Analysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits), Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Stripping voltammetry

Stripping Voltammetry**:** Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations**.**

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis**.** Advantages over anodic stripping voltammetry**.** Catalytic effects in voltammetry**.**

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes**.**

Electrochemical sensors (*Chemically modified electrodes****):*** Biosensors, catalytic sensors and gas sensors**.** Comparison of voltammetry with AAS and ICP**-**AES**.**

Unit-III: Electroanalytical methods

Electrogravimery: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

Cyclic voltammetry**:** Principle and technique**.** Randles**-**Sevcik equation**.** Interpretation of voltammogram**-** reversible, irreversible and quasi**-**reversible systems**.** Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes**.**

Unit IV: Water pollution and analysis

Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis

(DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation. Water treatment plants: Sand filters and other types of filters.

References

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)
10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
11. Analysis of Water: Rodier
12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)
13. Electroanalytical chemistry: Joseph Wang
14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)
15. Trace analysis: S. Lahiri (Narosa Publishing House)
16. Electroanalytical Chemistry: Bard (Marcel-Dekker)
17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

SEMESTER III

Practical 6

Practical based on Elective Paper (Any one of the four special practicals)

MCH3P06: Elective (a) Inorganic Chemistry Special Practical

4 h per week *100 Marks*

Course Outcomes: At the end of the course, student will be able to

1. *Prepare various complexes by wet chemical methods.*
2. *Carry out characterization of prepared complexes.*
3. *Interpret the electronic and magnetic properties of complexes.*
4. *Elucidate the spin states of various complexes using susceptibility studies.*
5. *Deduce the structures of crystalline solids.*
6. *Carry out photochemical reactions in complexes*

A) Complex preparations: Preparation and characterization of following complexes/organometallic compound including their structural elucidation by the available physical methods**. (**element analysis molecular weight determination, conductance and magnetic measurement and special studies**)**

1. Preparation of *cis* and *trans* potassium dioxalatodiaquochromate(III)
2. Preparation of hexa-aminecobalt(III) chloride
3. Preparation of *tris* (acetylacetonato) manganese(III)
4. Preparation of N-N *bis* (salicyldehyde) ethylene diaminonato nickel(II)
5. Preparation of trinitrotriaminocobalt(III)
6. Preparation of chloropentammine cobalt(III) chloride
7. To prepare copper(II) acetylacetonate complex
8. To prepare *cis* and *trans* bis (glycinato) Cu(II) monohydrate complex
9. To prepare dipyridineiodine(I) nitrate
10. Preparation of ammonium nickel(II) sulphate
11. *Any other complex depending on availability of chemicals.*

* Minimum 5 complexes should be prepared.

B. Nanomaterials and Synthesis Techniques

1. Preparation of Metal oxides and mixed oxides Nanomaterials by Conventional Methods (NiO, ZnO, TiO_2, CuO, Fe_2O_3, Fe_3O_4, Co_3O_4, $ZnFe_2O_4$, $ZnMn_2O_4$, $CuAl_2O_4$ and $NiFe_2O_4$)
2. Preparation of Metal oxides and mixed oxides Nanomaterials by Biogenic Methods (NiO, ZnO, TiO_2, CuO, Fe_3O_4, Fe_2O_3, Co_3O_4, $ZnFe_2O_4$, $ZnMn_2O_4$, $CuAl_2O_4$ and $NiFe_2O_4$)
3. Preparation of graphene oxide via *Hummer's* Method.
4. Preparation of graphitic carbon nitride using Urea, Thiourea, Melamine.

C) Separation techniques

1. Paper and thin layer chromatography

2. Ion exchange
3. Solvent extraction

D) Bioinorganic Chemistry

1. Extraction and absorption spectral study of chlorophyll from green leaves of student choice.

2. Separation of chlorophyll and their electronic spectral studies.

3. Preparation of plant extract using different parts of different biological sources.

References

1. Advanced Inorganic Analysis, S. K. Agarwal, K. Lal, Pragati Edition, Meerut.
2. Practical Inorganic Chemistry, G. Pass, H. Sutcliffe, Springer.
3. Practical Inorganic Chemistry - Marr & Rocket
4. Basic Concept of Analytical Chemistry - Khopkar S. M.
5. Vogel A: A Textbook of Quantitative Inorganic Analysis, Longman
6. Preparation And Properties of Solid-State Materials – Wilcox, Vol. IV & II, Dekker
7. The Structure and Properties of Materials – Vol IV, John Wulff, Wiley Eastern
8. Dutt P. K.: General And Inorganic Chemistry (Sarat Book House)
9. Fenton, David E.: Biocoordination Chemistry, Oxford
10. Jolly, W. L.: Inorganic Chemistry (4^{Th} Ed) Addison-Wesley
11. Bertini, et al: Bioinorganic Chemistry (Viva)
12. Katakis, D. And Gordon, G: Mechanism of Inorganic Reactions (J. Wiley)
13. Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques, and Applications, R. K. Goyal, Taylor & Francis, Boca Raton.
14. Biogenic Sustainable Nanotechnology, R. P. Singh, A.R. Rai, A. Abdala, R. G. Chaudhary, Elsevier, Amsterdam, Netherland.

SEMESTER III

Practical 6

MCH3P06: Elective (b) Organic Chemistry Special Practical

4 h per week *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Understand the types of reactions involved in organic synthesis.*
2. *Realize the various functional groups which are commonly present in simple organic molecules.*
3. *Develop skills to understand the reactions of different functional groups by the hands-on experience.*
4. *Characterize the synthesized compounds using IR spectroscopy*
5. *Draw the structures using Chem-Draw*

A) Organic preparations: Student is expected to carry out 4-7 two or three stage preparation from the following list. During preparation of organic compounds, the techniques such as crystallization, distillation, solvent extraction, TLC and column chromatography should be demonstrated.

1. Aniline → acetanilide →p-bromoacetanilide →p-bromoaniline
2. Aniline → Acetanilide →p-nitroacetanilide →p-nitroaniline
3. Benzaldehyde)thiamine hydrochloride→ (benzoin → benzil → benzilic acid
4. p-Nitrotoluene →p-nitrobenzoic acid→ PABA →p-iodobenzoic acid
5. p-Cresol → p-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone
6. Benzophenone → Benzophenone oxime → Benzanilide → Benzoic acid +aniline
7. Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
8. Aniline → N-arylglycine → indoxyl → indigo
9. Phthalimide → Anthranilic acid → Phenyl glycine-o-carboxylic acid → Indigo
10. Phalic anhydride → Phthalimide → Anthranilic acid → o-chlorobenzoic acid
11. Phalic anhydride → Phthalimide → Anthranilic acid →Diphenic acid
12. *Any other suitable three stage preparation as per the availability of chemicals*

B) Qualitative Analysis : Separation of the components of a mixture of three organic compounds)three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques .Minimum 4-6 mixtures to be analyzed.

C) IR spectroscopy: The IR spectrum of minimum four synthesized compounds from the Section A should be interpreted.

D) Use of Computers- Chem Draw, Chem Sketch for drawing simple organic molecules, aliphatic and aromatic compounds should be demonstrated (2 hour activity).

References

1. Practical organic chemistry by FG Mann and BC Saunders
2. Text book of practical organic chemistry –by Vogel
3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin

4. Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography by Basavarajaiah S M, Nagesh G Y, Ramakrishna Reddy K
5. Advanced Practical organic chemistry by N.K. Vishnoi

SEMESTER III

Practical 6

MCH3P06: Elective (c) Physical Chemistry Special Practical

4 h per week *100 Marks*

Course Outcomes: *At the end of the course students will be able to*

1. *Inculcate the potential of establishing any new laboratory at UG or PG level.*
2. *Execute the theoretical principles in practical*
3. *Analyze and interpret the results of their performances*
4. *Inculcate the skills of preparing, maintaining and developing the chemicals and reagents*
5. *Understand the role of laboratory safety and preparedness*

Thermodynamics:

1. Determination of partial molar volume of solute and solvent **(**ethanol-water, methanol-water, KCl-water mixture**)**

Solutions:

2. Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients**.**
3. Determination of temp**.** dependence of the solubility of a compound in two solvents having similar intermolecular interactions**(**benzoic acid in water and DMSO – water mixture**)** and calculation of the partial molar heat of solution**.**

Phase equilibrium:

1. To study the effect of addition of an electrolyte such as NaCl, KCl,Na_2SO_4,K_2SO_4 etc**.** on the solubility of an organic acid**(**benzoic acid or salicylic acid**).**
2. To determine the heat of crystallization of $CuSO_4$,$5H_2O$
3. To determine the heat of reaction involving precipitation of a salt $BaSO_4$
4. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method

Kinetics:

1. To determine the activation energy of hydrolysis of an ester by acid**.**
2. Kinetics of reaction between sodium thiosulphate and KI**.** Determination of rate constant; study of influence of ionic strength
3. Kinetics of decomposition of H_2O_2 catalysed by iodide ion**.** Also determination of activation energy of reaction**.**
4. Clock reaction**-** activation energy of bromide**-**bromate reaction**.**
5. Temp dependence of persulfate**-**iodide reaction by iodine clock method and calculation of thermodynamic and Arrhenius activation parameters**.** Study of ionic strength effect on persulfate-iodide reaction**.**
6. Kinetics of B**-**Z reaction; Kinetics of modified B**-**Z reaction
7. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid**.**
8. Determination of pKa value of a weak acid by chemical kinetic method **(**formate**-**iodine reaction**)**

Conductometry:

1. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.
2. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO_3) at several concentration and hence verify Onsager's equation.
3. Carry out the following precipitation titration conductometrically. a. 50 ml.0.02N $AgNO_3$ with 1N HCl; b.50 ml.0.02N $AgNO_3$ with 1N KCl; c. 50 ml 0.004 N $MgSO_4$ with 0.1 N $Ba(OH)_2$; d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4; e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4
4. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by conductometric method.
5. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
6. Complexation between $Hg^{2+}$and I^- conductometrically.
7. To determine solubility product of lead chromate.
8. Kinetic study of saponification ethyl acetate by conductometry.

Potentiometry:

1. To prepare calomel electrode and to determine the potential of calomel electrode by potentiometry.
2. To determine stability constant of Fe^{3+} with potassium dichromate in presence of dilute sulphuric acid by redox titration.
3. To determine solubility product of Silver chloride by potentiometric method.
4. Determination of redox potential of the couples(Fe^{2+}/Fe^{3+},Co^{3+}/Co^{2+},Cr^{3+}/Cr^{2+},MnO_4^- /Mn2+(any two) and equilibrium constant.
5. Study of complex formation by potentiometry e.g.Ag^+-$S_2O_3^{-2}$, Fe^{3+}-SCN^-,Ag^+-NH_3(any two) and calculation of stability constant.
6. Transport number by potentiometry.
7. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by potentiometry method.
8. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
9. Complexation between $Hg^{2+}$and I^- conductometrically.

Spectrophotometry:

1. To verify Beers law for solution of potassium permanganate and to find molar extinction coefficient.
2. To determine the indicator constant (pK_{In}) of methyl orange/red spectrophotometrically.
3. To determine the stability constant of reaction between Ferric ion solution and SCN^- ion solution by Job's method.
4. To determine the stability constant between Fe^{3+} and SCN^- ion solution by Ostwald and Frank method.

Polarography:

1. Determination of the half-wave potential of the cadmium ion in 1M potassium chloride solution.
2. Investigation of the influence of dissolved oxygen.
3. Determination of cadmium in solution.
4. Determination of lead and copper in steel.

Adsorption:

1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule

Transport Number:

1. To determine transport number by Hittorff's method
2. To determine the transport number by moving boundary method

References

1. Vogel A: A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty, Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood: Quantitative Analysis
7. Merits And Thomas: Advanced Analytical Chemistry
8. Ewing, G. W.: Instrumental Methods of Chemical Analysis, Mcgraw-Hill
9. Drago, R.S: Physical Methods in Inorganic Chemistry
10. Christian G.D: Analytical Chemistry
11. Khopkar S.M.: Basic Concept of Analytical Chemistry
12. Koltath And Ligane: Polorography
13. Braun: Instrumental Methods of Chemical Analysis
14. Willard, Merritt and Dean: Instrumental Methods of Chemical Analysis ,Van Nostrand
15. Strouts,Crifi; Llan And Wisin: Analytical Chemistry
16. Skoog S.A. And West D. W.: Fundamental of Analytical Chemistry
17. Dilts R.V.: Analytical Chemistry
18. Jahgirdar D.V : Experiments in Chemistry
19. Chondhekar T.K: Systematic Experiments in Physical Chemistry, Rajbhoj S.W., Anjali Pubn.
20. Wlehov G. J: Standard Methods of Chemical analysis 6th Ed

SEMESTER III

Practical 6

MCH3P06: Elective (d) Analytical Chemistry Special Practical

4 h per week *100 Marks*

Course Outcomes: At the end of the course, student will be able to

1. *Understand the fundamental principles forming basis for the instrumental methods of analysis.*
2. *Select most suitable technique for the desired analysis.*
3. *Identify experimental conditions necessary to carry out the analysis of different samples.*
4. *Compare results obtained through different techniques.*
5. *Formulate experiments based on optical and electroanalytical techniques.*
6. *Demonstrate working of each instrument used in analysis.*

pH-metry

1. Determination of percent Na_2CO_3 in soda ash by pH-metric titration.
2. Determination of isoelectric point of amino acid.
3. Determination of three dissociation constants of phosphoric acid.

Conductometry

1. Estimation of acids in mixtures.
2. Displacement titration of CH_3COONa with HCl.
3. Precipitation titration of $MgSO_4$ and $BaCl_2$.
4. Titration of mixture of CH_3COOH, H_2SO_4 and $CuSO_4$ with NaOH.
5. Determination of dissociation constants of weak acids.

Potentiometry

1. Estimation of Cl^-, Br^- and I^- in a mixture.
2. Determination of percent purity of phenol by potentiometric titration with NaOH.
3. Estimation of acids in mixtures.
4. Potentiometric titration of phosphoric acid with NaOH.

Electrogravimetry

1. Estimation of nickel and copper individually as well as in mixture.

Spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.
2. Simultaneous determination of two dyes in a mixture.
3. Estimation of Mn in steel.
4. Estimation of Cu/Ni in alloys.
5. Estimation of iron in water sample using 1,10-phenanthroline.
6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

1. Estimation of Li, Na, K, Ca in vegetable/ soil / water samples.

Polarography

1. Determination of $E_{1/2}$ of Cd^{2+} and Zn^{2+} at DME.
2. Estimation of Cd^{2+} and Zn^{2+} in respective solutions by calibration curve and standard addition methods.

Cyclic voltammetry

1. Study of cyclic voltammograms of $K_3[Fe(CN)_6]$.

Turbidimetry and nephelometry

1. Estimation of sulphate in water sample by turbidimetry.
2. Estimation of phosphate by nephelometry.
3. Determination of molecular weight of polymer.

Polarimetry

1. Determination of specific and molar rotation of optically active compound.
2. Kinetics of inversion of cane sugar in the presence of HCl.
3. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in mixture.

References

1. Quantitative analysis**:** Day and Underwood **(**Prentice**-**Hall of India**)**
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry**:** Gary D**.** Christian **(**Wiley India**).**
4. Experiments and calculations in Engineering Chemistry- S. S. Dara (S. Chand and Co.)
5. Experiments in Chemistry-D. V. Jahagirdar (Himalaya)
6. Advanced Practical Chemistry-J. B. Yadav (Goel Publishing House)
7. Advanced Practical Chemistry-Jagdamba Singh (Pragati Prakashan)

SEMESTER III

Practical 7

MCH3P07: Research Project (RP)

8 h per week *100 Marks*

The objective of research project is to train the student in identifying the problem of research, develop the hypothesis, design the experiments/surveys to test the hypothesis, collect and analyse the data and draw conclusions from it. In addition, the aim is also to prepare the student to present the data in various forms such as project report, presentation in conferences and seminars and research paper. Research project is also aimed to prepare the student for doctoral research after the completion of the programme.

The student will have to carry out a research-based project work in the third and fourth semester. The project work may be carried out in the parent department or any other institute in collaboration with the parent institute. For this, the student will be attached to any of the national/regional/private research institute/organization for the duration of the third semester. If the student is working in the organisation other than the parent department, then it will be the responsibility of the student to attend the classes and other departmental activities in order to be eligible to appear for the examination. The student will be allotted the supervisor in the third semester; after which the student will finalize the topic of the project work in consultation with the supervisor.

The research project of the student will be evaluated on the basis of the project report submitted by him/her and the power point presentation made by him/her in the presence of internal and external examiner during the examination.

SEMESTER IV

Paper 12

MCH 4T12: Spectroscopy-II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course, student will be able to*

1. *Interpret the structures of simple molecules using physical methods of analysis*
2. *Understand and interpret the NMR data*
3. *Analyze X ray diffraction data*
4. *Develop the skills of analytical ability*
5. *Execute out the combined application of spectral method*

Unit I:

A) Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. General nature of band spectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect of solvent and conjugation on electronic transitions, Fieser Wooodward rules for dienes, aldehydes and ketones. Structure differentiation of organic molecules by UV Spectroscopy

B) Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem, PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II:

Nuclear Magnetic Resonance Spectroscopy: Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spin interaction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organic molecules, effect of deuteration, complex spin spin interaction (1^{st} order spectra), stereochemistry, variations of coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules as AX, AX_2, AMX, A_2B_2, Shift reagents. NMR studies of ^{13}C, chemical shift in aliphatic, olefinic, alkyne, aromatic, heteroatomic and carbonyl compounds, ^{19}F, ^{31}P. Structure determination of organic molecules by NMR spectroscopy

Unit III:

A) Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, two-dimensional NMR spectroscopy-COSY, HETCOR, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclear Overhauser effect, use of NMR in medical diagnosis

B) Problems based on structure determination of organic molecules by using NMR (^1H and ^{13}C nuclei) data, Structure elucidation using combined techniques including UV, IR, NMR and mass spectrometry (based on data and copies of the spectra)

Unit IV:

Diffraction techniques: X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method, identification of unit cells from systematic absences in diffraction pattern, structure of simple lattices and x-ray intensity, structure factor and its relation to intensity and electron density, absolute configuration of molecules.

Electron diffraction: scattering intensity vs scattering angle, Wierl equation, measurement techniques, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques, elucidation of structure of magnetically ordered unit cell.

References

2. Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
3. Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
4. Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
5. Organic Spectroscopy-William Kemp, ELBS with McMillan
6. Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
7. Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8. Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9. Fundamentals of Molecular Spectroscopy-CN Banwell
10. Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11. Photoelectron Spectroscopy-Baber and Betteridge
12. Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13. NMR –Basic Principle and Application-H Guntur
14. Interpretation of NMR spectra-Roy H Bible
15. Interpretation of IR spectra-NB Coulthop
16. Electron Spin Resonance Theory and Applications-W gordy
17. Mass Spectrometry Organic Chemical Applications, JH Banyon

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Weblink to Equivalent MOOC on SWAYAM if relevant:

- Application of Spectroscopic Methods in Molecular Structure Determination https://nptel.ac.in/courses/101/104/104106075/

SEMESTER IV

Paper 13

MCH 4T13: Advanced Organic Chemistry II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course, student will be able to*

1. *Recognize the chemical reactions of carbonyl compounds and alkenes under photochemical conditions*
2. *Understand the stereochemistry of complex organic molecules*
3. *Apply the knowledge of enaolate chemistry in modern organic synthesis*
4. *Demonstrate the applications of stereochemistry of common organic reactions*
5. *Analyze the philosophy of synthesis of small molecules*

Unit I: Organic Photochemistry

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones

Photochemistry of *p*-benzoquinones, photochemistry of aromatic compounds with reference to isomerization, addition and substitution Photochemical isomerization of *cis* and *trans* alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, di-pi methane rearrangement, Photo theory reaction of anilides, photochemistry of vision, DeMayo reaction

Unit II:

Advanced Stereochemistry

A) Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homo topic and heterotopic ligands, racemization and resolution methods, Chemo-, regio-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesis, use of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation

B) Stereochemistry of fused and bridged ring systems: Nomenclature, synthesis; stereochemical aspects of Perhydrophenanthrene, Perhydroanthracene, hydrindane, Steroids; Bridged system (bi, tri and polycyclo system) including heteroatoms, Bredt's Rule. Conformations of following compounds with justification of each: *cis* and *trans*-1,3- and l,4-di-t-butyl-cyclohexanes; Cis-4-di-t-butylcis-2,5-dihydroxycyclohexane; Twistane; bicyclo-[2.2.2]octane; Trans-anti-trans-Perhydro-anthracene and the lactone; cyclohexane-l,4-dione; 1,2,2,6,6-penta-methyl-4- hydroxy-4-phenylpiperidine; ψ-tropine; 2-hydroxy-2-phenyl quinolizidine; 4-*t*-butyl-4-methyl-l,3-dioxane; *cis*-and *trans*-2,5-di-t-butyl-l,3-dithianes; *cis*-2,5-di-t-butyl-l,3,2- dioxaphosphorinan-2-one

Unit III:

Alkylation of enolates and other carbon nucleophiles: Generation and properties of enolates and other stabilized carbaions, regioselectivity and stereoselectivity in enolate formation from ketones and esters, alkylation of enolates of ketones, aldehydes, esters, carboxylic acids, amides, and nitriles, Generation and alkylation of dianions, intramolecular alkylation of enolates, control of enantioselectivity in alkylation reactions, The nitrogen analogs of enols and enolates: Enamine and imine anions

Reactions of carbon nucleophiles with carbonyl compounds: Aldol addition and condensation reaction, mechanism, Control of regioselectivity and stereoselectivity of aldol reacions of aldehydes and ketones, Aldol addition reactions of enolates of esters and other carbonyl derivatives, Reaction of (*E*) or (*Z*)-enolates with chiral aldehydes, The Mukaiyama aldol reaction, Control of facial selectivity in aldol and Mukaiyama aldol reaction, Intramolecular aldol reaction and the Robinson annulation, Evans aldol reaction, Mannich reaction, Conjugate addition of enolates, organomettalic reagents and cyanide ion, Conjugate addition with tandem alkylations, Control of facial selectivity in conjugate addition reaction

Unit IV: Designing the synthesis based on retrosynthetic analysis

A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis

B) One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis

C) Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalisedcompounds, Michael addition and Robinson annelation, Methods of ring synthesis, Linear and convergent synthesis

References

1. N. J. Turro, "Modern Molecular Photochemistry" (MMP), University Press, Menlo Park, CA, 1978
2. A. Gilbert and J. Baggott, "Essentials of Molecular Photochemistry," CRC Press, London, UK, 1991
3. J. Mattay and A. Griesbeck, eds., "Photochemical Key Steps in Organic Synthesis", VCH, New York, 1994
4. J. D. Coyle, ed., "Photochemistry in Organic Synthesis", Royal society of Chemistry, London, 1986
5. Stereochemistry of Organic Compounds Principles and Applications by D. Nasipuri, 3rd Edition, New Age International (P) Ltd Publishers
6. Basic Stereochemistry of Organic Molecules, 2nd Edition, Book Syndicate Pvt. Ltd

7. Basic Organic Stereochemistry by Ernest L. Eliel, Samuel H. Wilen and Michael P. Doyle, 2001 edition, Wiley Interscience.
8. Advance Organic Chemistry Part-B-F .A .Caray and R .J .Sundberg Plenum Press (Useful for Unit III)
9. Organic Chemistry, J .Clayden, N .Greeves, S .Warren and P .Wothers, Oxford University Press
10. Some Modern Methods of Organic Synthesis-W .Carruthers
11. Principles of Organic Synthesis by R. O. C. Norman and James M. Coxon (Nelson Thornes Ltd)
12. Modern Organic Synthesis: An Introduction by G. S. Zweifel and M. H. Nantz (Wiley)
13. Organic Synthesis by Michael Smith , 4th Edition (Academic Press)
14. Organic Synthesis: The Disconnection Approach-S. Warren
15. Designing Organic Synthesis-S. Warren

Weblink to Equivalent MOOC on SWAYAM if relevant:

- Organic Photochemistry and Pericyclic Reactions: Dr. N.D. Pradeep Singh Department of Chemistry IIT Kharagpur, https://nptel.ac.in/courses/104105038
- Pericyclic Reactions and Organic Photochemistry: Prof. Sankararaman, IIT Madras https://nptel.ac.in/courses/104/106/104106077/
- A Study Guide in Organic RetrosynthesisL Problem Solving Approach: Prof. Samik Nanda, IIT Kharagpur https://nptel.ac.in/courses/104105087
- Stereochemistry: Prof. Amit Basak, IIT Kharagpur https://nptel.ac.in/courses/104105086
- Stereochemistry and Applications: Prof. A. R. Choudhury, IISER Mohali https://nptel.ac.in/courses/104106127
- Structure, Stereochemistry and Reactivity of Organic Compounds and Intermediates: A Problem-solving Approach: Prof. Amit Basak, IIT Kharagpur https://nptel.ac.in/courses/104105127

SEMESTER IV

Paper 14

MCH 4T14**: Advanced Physical Chemistry**

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course, student will be able to*

1. *Understand the types and behavior of solids based on their structure.*
2. *Estimate various dependent parameters of under different influences.*
3. *Understand solid state reactions and synthesis process.*
4. *Understanding nano chemistry.*
5. *Identification of crystals and their analysis.*

UNIT I: SOLID STATE AND THEIR MAGNETIC PROPERTIES

A**)** Solid State Chemistry**:** Metals, Insulators and Semiconductors, Electronic structure of solids-band theory**.** Band structure of metals, Insulators and Semiconductors, Intrinsic and Extrinsic Semiconductors, p-n junction, energy band formation, forward bias and reversed bias p-n junction, their applications, Superconductors— types, Meissner effect, BCS theory, Low Temperature Superconductor **(**LTSC**)** and High Temperature Superconductor **(**HTSC**)**, Conventional and organic Superconductors, their applications**.**

B**)** Magnetic Properties**:** Behaviour of substances in magnetic field, effect of temperature, Curie and Curie-weiss law, calculation of magnetic moments, magnetic materials, their structure and properties, Applications, structure/ property relations, numerical**.**

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization, Debye equations, limitation of the Debye theory, Clausius-Mossotti equation**.** electrostatic of dielectric medium, molecular basis of dielectric behavior, structural information from dipole moment measurements, use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment and ionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids and in solutions**.** The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction**.** Dispersion, dielectric loss and refractive index**.** Lennard-Jones potential**.**

UNIT III: THIN FILMS AND LIQUID CRYSTALS

(A) Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel, etc. Langmuir Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

(B) Liquid crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases, smectic-nematic transition and clearing temperature- homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular rearrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

UNIT-IV: CRYSTAL STRUCTURES

A) Introduction to crystals, Unit Cell and lattice parameters, Symmetry elements in crystals, Absence of fivefold axis, Space groups, The Bravais Lattices, Miller Indices, Bragg's Equation, seven crystal system, packing in crystals, Hexagonal Closest Packing (HCP) Cubic Closest Packing (CCP), Voids, packing fraction, Numerical.

B) **Lattice Defects:** Perfect and Imperfect crystals, point defects**,** Interstitial, Schottky defect, Frenkel defect, line defect and other entities, thermodynamics of Schottky and Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects and their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronicproperties of Non-stoichiometric oxides.

References

1. S**.** O**.** Pillai, Solid State Physics, New Age International, New Delhi, 2102**.**
2. C**.**Kittel, **"** Introduction to solid state Physics**"**,Wiley
3. L**.**V**.**Azaroff, **"** Introduction to solids**"**, McGraw Hill

SEMESTER IV

Paper 15

MCH4T15: Elective (a) Inorganic Chemistry Special II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student would be able to

1. *Understand the types and behavior cerasmic and composite materials.*
2. *Elaborate various types of ceramics and cementataceous composites.*
3. *Discuss corrosion types, reasons and solutions to corrosion problem.*
4. *Comprehend industrial materials and water treatment techniques.*
5. *Prepare a subject platform for energy sources and renewable fuel sources.*

Unit-I

a. Ceramic Materials: Classification of ceramics, dielectric properties and polarization properties of ceramics, piezo-, pyro- and ferro-electric effect of ceramics, sol-gel processing of ceramics. Examples and application of ceramics: oxides, carbides, borides, nitrides.

b. Composite Materials: Definition, glass transition temperature,fibersfor reinforced plastic composite materials (i.e. glass fibers, carbon fibres, and aramid fibers); concrets and asphalt materials. Application ofcomposite material.

Unit-II

A) Cementitious Materials: Difference between Blended and Non-Portland cements; Non-portland cements; high alumina cements, calcium sulfoaluminate cements, phosphate cements.Chemicals in cement hydration; hydration process, set retardersandaccelerators, plasticizers, slip-casting processing. Application of cementitousmaterials.

B) Bio-materials: Definition of biomaterials and biocompatibility;, Type of bio-materials: Metallic materials, Biopolymeric materials, Bioceramic materials (dense hydroxyapatite ceramics, bioactive glasses,and bioactive composites); Basic requirement of bone implants; Coating of hydroxyapatite on porous ceramics; Biomaterials in tissue attachments; Application of Biomaterials

Unit-III

A) Inorganic Chemicals as metallic Corrosion Inhibitors: Introduction, Principles of corrosion inhibitors, corrosion as an electrochemical process, Practical aspects of corrosion inhibition, Anion inhibitor properties in neutral electrolytes, some application of corrosion inhibitors (cooling water circulation-once through and open systems, engine radiation & cooling systems, central heating system, refrigeration plants and high chloride systems, water for steam raising, corrosion inhibitors for paintcoating).

B) Industrial gases: Introduction, Separation of gases from air,Hydrogen, Carbon dioxide, Carbon monoxide, Oxygen, Acetylene, Sulphur dioxide, Nitrous oxides.

C) Chemical explosives and propellants: Introduction, Potential energy of explosives , Properties of explosives, Manufacture of explosives , Explosives made by nitration, Dynamite , Commercial

high explosives containing no nitroglycerine , Initiating devices, Sporting and military explosives, Disruptive explosives for military use, Handling and storage of explosives.

Unit-IV

A) Applications of Biotechnology for the treatment of waste water: Introduction, Role of microorganism for the treatment of waste water, Application of biotechnology for a. high strength waste. b. Primary and secondary sludge c. Phenol & cyanide removal d. Solid phase extraction

B) Energy sources for future:

a. Solar Energy-Solar heating for homes and other buildings, electricity from solar thermal power collectors, electricity from photovoltaic cells.

b. Energy from biomass- Production of biomass, biofuels, biodiesel.

c. Geothermal energy,

d. water power

e. Tidal power.

f. Fuel Cells-Polymer electrolyte membrane fuel cells, Phosphoric acid fuel cell, Direct methanol fuel cell, Alkaline fuel cell, Regenerative(reversible) fuel cell, Clean cars for the future, Energy sources for the twenty first century.

References

1. Handbook of Industrial Chemistry,Vol.1, by K.H.Davis,F.S.Berner,Edited by S.C. Bhatia (CBS Publishers, Bangalore,2004)
2. Industrial inorganic chemistry, Karl Heinz Buchel, Hans-Heinrich Moretto, Peterwoditsch
3. Modern Electroplating, By M. Schlesinger and M. Paunovic (John Wiley and sons, Hoboken , New Jersey, 5th Edition2010)
4. Insight into Specialty Inorganic Chemicals-David Thompson (The Royal Society of Chemistry,1995)- Chapter 15.
5. New Trends in Green Chemistry (2nd Edition)-V.K.Ahluwalia and M.Kidwai (AnamayaPublishers, 2007)
6. Environmental Chemistry by A. K. Bagio.
7. Principles of Environmental Chemistry by James Girard Bartlett Publishers.
8. Waste Water Engineering by Calf& Eddy.
9. Waste Water treatment for pollution control by Arceivala.
10. Principles of water quality Control by T. H. Y Tebbut.
11. Manual on Sewage &Sewage treatment, Ministry of Works, New Delhi.

SEMESTER IV

Paper 15

MCH4T15: Elective (b) Organic Chemistry Special-II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: *At the end of the course students would be able to*

1. *Understand the reactivity of organometallic compounds*
2. *Demonstrate the applications of organometallic reagents in C-C bond formation*
3. *Understands the reactivity of heterocyclic compounds in various reaction conditions*
4. *Understand the electrophilic, nucleophilic reactions and synthesis of various heterocycles*
5. *Justify the need of protecting groups in organic synthesis*

Unit I:

Organometallic compounds of Group I and II Metals: Synthesis and applications of organolithium and organomagnesium reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition to carbonyl compounds, *o*-metallation of arenes using organolithium compounds, Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates, Gilman's reagent. Organo Hg and Cd reagents in organic synthesis, Reformatsky reaction, Barbier reaction

Unit II: Heterocycles-I

a) Ring Synthesis: Introduction, Cyclization reactions: Reaction types, displacement at saturated carbon, intramolecular nucleophilic addition to carbonyl groups, intramolecular addition of nucleophiles to other double bonds, cyclizations on to triple bonds, radical cyclizations, cabene and nitrene cyclization, electrocyclic reactions, reactions and structural effects of heterocyclic rings, ,3 - dipolar cycloadditions producing five - membered heterocycles, Hetero Diels-Alder reaction, [2+2] cycloaddition, ene reactions, Palladium catalysis in the synthesis of Benzo - Fused heterocycles

b) Three and four membered heterocylces: Aziridines, Oxiranes, Thirienes, Azetidines, Oxetanes and Thietanes

C) Azoles: Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages, Carbonyldiimidazole as coupling agent

Unit III: Heterocycles-II

A) Benzofused heterocycles: Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology, Synthesis and reactions of coumarin

B) Diazines: Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

C) Synthesis of following bioactive compounds: Vitamin B6, Ondansetron, Serotonin, Indometacin, Cyanamid, fentiazac, trimethoprim, papaverine

Unit IV:

A) Protection and de-protection of functional group in organic synthesis: Hydroxyl group- alkyl ether, benzyl ether,acyl, PMB, Trityl, TMS, TBDMS, THP, MOM, MEM, MIP ether; Diol- Acetone, Cyclohexanone; Amines- Benzyl, Acyl, CBZ, BOC, FMOC, Carboxyl group-Ester, DCCI, DIPCDI; Ketone and aldehydes- Glycol, Thioglycol, Ketal, Acetal; Othroesters as protecting groups, Protection deprotection approach - In Solid phase synthesis of polypeptide

B) Total synthesis selected molecules: FR-900848, cubane, biotin, longifolene and taxol, Endiandric Acid A, B, C and D

References

1. Organometallics: A concise Introduction, Ch. Elshebroicn and A. Salzer, VCH, chapters, 12-16
2. Organotransition Metal Chemistry: Applications to Organic Synthesis, S.G. Davies, Permagaon 1982.
3. Organometallics in Organic Synthesis – Swan & Black
4. Organometallic Chemistry - E.J. Elias and Gupta
5. Aromatic Heterocyclic Chemistry (Oxford Chemistry Primers) by David T. Davies
6. Heterocyclic Chemistry (3rd Edition) by Thomas. L. Gilchrist (Useful for Unit II)
7. Heterocyclic Chemistry by John A. Joule and K. Mills
8. The Chemistry of Heterocycles: Structure, Reactions, Syntheses, and Applications by Theophil Eicher and Siegfried HauptmannPrincipal of Modern Heterocyclic Chemistry-L .A .Paquelte
9. Heterocyclic Chemistry-Morton
10. An Introduction to Chemistry of Heterocyclic Compound-J .B .Acheson
11. Heterocyclic Chemistry by Dr Thomas. L. Gilchrist 3rd edition (Prentice Hall) for Unit II
12. Protective Groups in Organic Synthesis-T. W. Greene
13. Organic Chemistry, J .Clayden, N .Greeves, S .Warren and P .Wothers, Oxford University Press
14. Modern Organic Synthesis: An Introduction by G. S. Zweifel and M. H. Nantz (Wiley)

Weblink to Equivalent MOOC on SWAYAM if relevant:

- Organometallic Chemistry: Prof. D. Maiti, IIT Bombay
  https://nptel.ac.in/courses/104/101/104101079/
- Metal Mediated Synthesis: Prof. D. Maiti, IIT Bombay
  https://nptel.ac.in/courses/101/104/104101092/
- Transition Metal Organometallics in Catalysis and Biology: Prof. P. Ghosh, IIT Bombay
  https://archive.nptel.ac.in/courses/104/101/104101123/
- Classics in total synthesis: Prof. Krishna P. Kaliappan, IIT Bombay
  https://archive.nptel.ac.in/courses/104/101/104101133/
- Heterocyclic Chemistry: Prof. D. R. Mal, IIT Kharagpur
  https://archive.nptel.ac.in/courses/104/105/104105034/

SEMESTER IV

Paper 15

MCH4T15: Elective (c) Physical Chemistry Special-II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course students will be able to

1. *Execute the chemical dynamical calculations and research applications*
2. *Understand the applications of electrochemistry in industrial as well as research applications*
3. *Analyze the applications of radiation chemistry*
4. *Gain the knowledge of battery technology and their operations so as to work in the concerned research field*
5. *Understand, analyze and execute the concepts of quantum mechanics in various fields*

UNIT-I CHEMICAL DYNAMICS - II

A) Overview of Arrhenius rate law, Non-conventional equilibrium between reactants and activated complexes. Potential energy surfaces and reaction coordinate. Derivation of transition state theory-based equation for rate constant of bimolecular reaction. Prediction of rate constant using partition function and comparison with that given by collision theory. Arrhenius equation and activated complex theory. Transmission coefficient, quantum mechanical tunneling,

B) Reactions in solution: Cage effect, diffusion-controlled reactions, volume of activation its determination and correspondence with entropy of activation, Ionic reactions: Primary (Ionic strength) and Secondary salt effect and their nature.

UNIT II CORROSION AND CORROSION ANALYSIS

A) Scope and economics of corrosion, causes (Change in Gibbs free energy), Electrochemical Series and Galvanic series, dry (atmospheric) and wet (electrochemical) corrosion, other types of corrosion-Pit, Soil, chemical and electrochemical, inter-granular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

B) Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarization methods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coating methods).

UNIT – III: RADIATION CHEMISTRY AND BATTERY TECHNOLOGY

A) Interaction of radiation with matter, radiation track spurs and γ-rays. Linear energy transfer, Bathe's equation for linear energy transfer, Bresstrahlung effect, Passage of neutron through matter, Interaction of γ -radiation with matter, photoelectric effect and Compton effect, pair production phenomena, units of measuring radiation absorption, Chemical Dosimeters, Fricke Dosimeter and Ceric Sulphate Dosimeter, Conversion of measured dose values, Radiolysis of water, Radiolysis of some aqueous solutions. Effect of radiation on biological substances, genetic effects, Radiation effects on organic compounds and Polymers.

B) Battery Technology: basic concept, classification of batteries, primary, secondary and reserve batteries, Construction, working and application of Acid Storage batteries, Lithium -MnO_2

batteries, Nickel- Metal hydride batteries, Fuel Cells, Construction and working of $H_2O_2$and methanol-O_2 Cell.

UNIT IV: THE LIQUID STATE AND SOLUTIONS

A] Introduction, The van der Waals Approximation, Cell theory, Hole Theory, Radial Distribution Function Methods, Radial Distribution Functions and the Thermodynamic Functions, Other Theories, Applications of these theories.

B] Introduction to solutions, Lattice Models, Ideal solutions, non-ideal or regular Solutions (Bragg-Williams Approximation), Incomplete Miscibility, Dilute Solutions, Polymer Solutions.

References

1. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations McMilllan IndianLtd., New Delhi (1993)
5. C. H. Bamford and C. F. H. Tipper, Comprehensive Chemical Kinetics, **Vol 1**., Elsevier Publications, New York, 1969.
6. Gholam-Abbas Nazri, Gianfranco Pistoia, Lithum Batteries-Science and Technology, Springer, 2003.
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8. S. Glasstone, K. J. Laidler and H. Eyring, The Theory of Rate Processes, Mc-Graw Hill, New York, 1941.
9. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
10. D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000
11. G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.
12. H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.
13. S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.
14. C.Kittel, **"** Introduction to solid state Physics**"**,Wiley
15. L.V.Azaroff, **"** Introduction to solids**"**, McGraw Hill
16. Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.
17. N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,
18. N. B. Hanny, "Solid State Chemistry"
19. M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,
20. C.N.Rao. Nuclear Chemistry
21. B. G. Harvey, Introduction to Nuclear Physics and Chemistry, Prentice Hall, Inc. (1969).
22. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.

23. W. Loveland, D. Morrissey and G. Seaborg, Modern Nuclear Chemistry, Wiley-Interscience, 2006.
24. P. P. Milella, Fatigue and Corrosion in Metals, Springer, 2013.
25. Corrosion- Understanding the Basics, asminternational.org, 2000.
26. H. H. Uhlig, Corrosion and Corrsion Control – 3rd edn, John Wiley and sons, New York.
27. J. W. T. Spinks and R. J. Woods, An Introduction to Radiation Chemistry, John Wiley and sons., New Yoek, 1975.
28. K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

SEMESTER IV

Paper 15

MCH4T15: Elective (d) Analytical Chemistry Special-II

60 h (4 h per week): 15 h per unit *100 Marks*

Course Outcomes: At the end of the course, student will be able to

1. *Understand the fundamental principles forming basis for the instrumental methods of analysis.*
2. *Select most suitable technique for the desired analysis.*
3. *Identify experimental conditions necessary to carry out the analysis of different samples.*
4. *Formulate experiments based on optical and electroanalytical techniques.*
5. *Demonstrate working of each instrument used in analysis.*

Unit-I: Optical methods of analysis-IV

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation**.** Plasma source and sample introduction**.** Instrumentation**.** Comparison of ICP-AES with AAS**.** Applications**.**

X-ray fluorescence spectroscopy: Principle**.** Instrumentation**:** wavelength and energy dispersive devices**.** Sources and detectors**.** Comparison between wavelength and energy dispersive techniques**.** Sample preparation for XRF**.** Matrix effects in XRF**.** Applications in qualitative and quantitative analysis**.**

Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy **(**SEM**)** and transmission electron microscopy **(**TEM**)**

Unit-II: Electrochemical methods of analysis-IV

Ion selective electrodes: Theory of membrane potential**.** Types of ion**-**selective electrodes**.** Construction of solid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes, Selectivity coefficients, Glass electrodes with special reference to H^+, Na^+ and K^+ ions**.** Applications of ISE in analysis of environmentally important anions like F^-, Cl^-, Br^-, I^-, NO_3^- and CN^-**.** Advantages of ISE**.**

Coulometry**:** Principle**.** Coulometry at constant potential and constant current**.** Instrumentation**.** Applications and advantages of coulometric titrations**.**

Electrochemical microscopy**:** Introduction to scanning probe microscopy **(**SPM**)**, scanning tunneling microscopy **(**STM**)**, atomic force microscopy **(**AFM**)** and scanning electrochemical microscopy **(**SECM**).**

Unit-III: Thermal methods of analysis

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistatic thermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750, Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)- Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis, Differential Scanning Calorimetry (DSC)- Introduction, Instrumentation, DSC curves, factors affecting DSC curves, applications, Thermogravimetric titration-Theory, Instrumentation and applications.

Unit-IV: Air pollution and analysis

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO_2, NO_2, CO, CO_2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

References

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
4. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
5. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery,Mendham (ELBS)
6. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
7. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
8. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
9. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
10. Analysis of Water: Rodier
11. Ion selective electrodes: Koryta (Cambridge University Press)
12. Industrial Chemistry: Arora and Singh (Anmol Publications)
13. Diffraction Methods: John Wormald (Clarendon Press)
14. Electroanalytical Chemistry: Bard (Dekker)
15. Analytical Chemistry by Open Learning (Wiley)
16. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
17. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
18. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)
19. Indian Pharmacoepia, Vol-I, II and III.

Web link for related NPTEL courses

Analytical Chemistry: https://nptel.ac.in/courses/104105084

SEMESTER IV

Practical 8

MCH4P08: Major Research Project

12 h per week *200 Marks*

The objective of research project is to train the student in identifying the problem of research, develop the hypothesis, design the experiments/surveys to test the hypothesis, collect and analyse the data and draw conclusions from it. In addition, the aim is also to prepare the student to present the data in various forms such as project report, presentation in conferences and seminars and research paper. Research project is also aimed to prepare the student for doctoral research after the completion of the programme.

The student will have to carry out a research-based project work in the third and fourth semester. The project work may be carried out in the parent department or any other institute in collaboration with the parent institute. For this, the student will be attached to any of the national/regional/private research institute/organization for the duration of the fourth semester. If the student is working in the organisation other than the parent department, then it will be the responsibility of the student to attend the classes and other departmental activities in order to be eligible to appear for the examination. The student will be allotted the supervisor in the third semester; after which the student will finalize the topic of the project work in consultation with the supervisor.

The research project of the student will be evaluated on the basis of the project report submitted by him/her and the power point presentation made by him/her in the presence of internal and external examiner during the examination.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Scheme of Teaching and Examination

for

Two year Post Graduate Programme

M. Sc. (Microbiology)

(As per NEP 2020 Structure and Credit Distribution)

Course Effective from 2023-2024

Scheme of Teaching and Examination for M. Sc. (Microbiology)

As per NEP 2020 Structure and Credit Distribution of PG Degree Program

for Two Year Choice Based Credit System (Semester Pattern)

Effective from 2023-2024

Semester I

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total (Hrs)	Total Credit	Examination Scheme						
									Theory				Practical		
				(Th)	TU	P			Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Microbial Metabolism	MMI1T01	4	-	-	4	4	3	80	20	40	-	-	-
2	DSC	Enzymology and Techniques	MMI1T02	4	-	-	4	4	3	80	20	40	-	-	-
3	DSE	Elective 1 (Choose any One) 1. Advance Techniques in Microbiology 2. Membrane Structure and Signal Transduction	MMI1T03	4	-	-	4	4	3	80	20	40	-	-	-
4	RM	Research Methodology	MMI1T04	4	-	-	4	4	2	80	20	40	-	-	-
5	LAB 1	Practical I	MMI1P01	-	-	6	6	3	2-6*				50	50	50
6	LAB 2	Practical II (Including Research Methodology)	MMI1P02	-	-	6	6	3	2-6*				50	50	50
Total				16	-	12	**28**	**22**	**-**	**320**	**80**	**160**	**100**	**100**	**100**

Marks of Theory Component= 400 Marks of Practical Component= 200 TOTAL = 600
Min.Passing: 160+100= 260

Semester II

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total (Hrs)	Total Credit	Examination Scheme						
									Theory				Practical		
				(Th)	TU	P			Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Environmental Microbial Technology	MMI2T05	4	-	-	4	4	3	80	20	40	-	-	
2	DSC	Immunology and Immunodiagnostics	MMI2T06	4	-	-	4	4	3	80	20	40	-	-	
3	DSE	Elective 2 (Choose any one) 1. Microbial Metabolites 2.Pharmaceutical Microbiology	MMI2T07	4	-	-	4	4	3	80	20	40	-	-	
4	OJT	On Job Training / Field Project	MOJ2P01	-	-	8	8	4	3-8*	-	-	-	50	50	50
5	LAB 3	Practical III	MMI2P03	-	-	6	6	3	2-6*	-	-	-	50	50	50
6	LAB 4	Practical IV	MMI2P04	-	-	6	6	3	2-6*	-	-	-	50	50	50
Total				12	-	20	**32**	**22**		**240**	**60**	**120**	**150**	**150**	**150**

Marks of Theory Component = 300 Marks of Practical Component= 300 TOTAL = 600
Min. Passing: 120+150= 270

Semester III

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total (Hrs)	Total Credit	Examination Scheme						
									Theory				Practical		
				(Th)	TU	P			Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Microbial Diversity,Evolution and Ecology	MMI3T08	4	-	-	4	4	3	80	20	40	-	-	-
2	DSC	Molecular Biology and Genetics	MMI3T09	4	-	-	4	4	3	80	20	40	-	-	-
3	DSC	Recombinant DNA Technology and Nanobiotechnology	MMI3T10	4	-	-	4	4	3	80	20	40	-	-	-
4	DSE	Elective 3 (Choose any one) 1. Drug and Disease Management 2. Bioinformatics	MMI3T11	4	-	-	4	4	3	80	20	40	-	-	-
5	LAB 5	Practical V	MMI3P05	-	-	4	4	2	-	-	-	-	50	50	50
6	RP	Research Project/ Dissertation (Core)	MRP3P01	-	-	8	8	4	-	-	-	-	50	50	50
Total				16	-	12	**28**	**22**		**320**	**80**	**160**	**100**	**100**	**100**

Marks of Theory Component= 400 Marks of Practical Component= 200 TOTAL = 600
Min.Passing: 160+100=260

Semester IV

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total (Hrs)	Total Credit	Examination Scheme						
									Theory				Practical		
				(Th)	TU	P			Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Virology	MMI4T12	4	-	-	4	4	3	80	20	40	-	-	-
2	DSC	Microbial Fermentation & Techniques	MMI4T13	4	-	-	4	4	3	80	20	40	-	-	-
3	DSC	Medical Microbiology and Parasitology	MMI4T14	4	-	-	4	4	3	80	20	40	-	-	-
4	DSE	Elective 4 (Choose any one) 1. Vaccinology 2. Bioethics, Biosafety and IPR	MMI4T15	4	-	-	4	4	3	80	20	40	-	-	-
5	RP	Research Project / Dissertation (Core)	MRP4P02	-	-	12	12	6	-	-	-	-	100	100	100
Total				16	-	12	**28**	**22**		**320**	**80**	**160**	100	100	100

Marks of Theory Component= 400 Marks of Project Component= 200 TOTAL = 600

Min. Passing: 160+100=260

2 Years-4 Sem. PG Degree (88 credits) after Three Year UG Degree or
1 Year-2 Sem PG Degree (44 credits) after Four Year UG Degree

Total Credits for Four Semesters (Two Year Course): 4 * 22 = 88

Total Marks for Four Semesters (Two Year Course): 4 * 600 = 2400

Basket for ELECTIVE (DSE) Category Courses (Microbiology)

Semester	Course Category	Name of Course	Course Code
I	Elective 1	A. Advance Techniques in Microbiology B. Membrane Structure and Signal Transduction	MMI1T03
II	Elective 2	A. Microbial Metabolites B. Pharmaceutical Microbiology	MMI2T07
III	Elective 3	A. Drug and Disease Management B. Bioinformatics	MMI3T11
IV	Elective 4	A. Vaccinology B. Bioethics, Biosafety and IPR	MMI4T15

Abbreviations:

DSC: Discipline Specific Course, **DSE**: Discipline Specific Elective **SEE:** Semester End Examination**, CIE:** Continuous Internal Evaluation, **OJT:** On the Job Training (Internship/Apprenticeship), **FP:** Field Project, **RM:** Research Methodology, **RP**: Research Project

EVALUATION and DISTRIBUTION OF MARKS

(1) Continuous Internal Evaluation (CIE): Twenty (20) marks

a. Mid-Semester Examination: Maximum Marks 10, Duration of Examination: One Hour, Pattern of Question Paper: Multiple Choice Questions, Mode of examination: Online or offline.

b. Overall Participation: Maximum 10 Marks (Such as, Attendance in theory classes, seminar, assignment, quiz, participation in field tours, conferences, workshops, and the general behaviour in the department.)

Note: Total Marks of CIE will be 20 (i.e., 10+10). A candidate must have to secure minimum 50% marks (i.e., 10 out of 20 marks). Failing so, he/she shall not be allowed to appear in End Semester Examination.

(2) Semester End Examination (SEE)

a. Theory Paper: Maximum Marks: 80 (Eighty), Duration of Examination-Three Hours, The paper will be set so as to cover all units/sections of the syllabus as below:

Type of questions	Total Number of questions with Marks	No. of questions to be	Marks for Each Question	Total maximum marks
• Short answer questions • Long answer questions	**4 + 1 = 5** one long question from each unit (16 marks each) or two questions from each unit (8+8=16 marks each) + one short question on each unit (4 marks each)	**5**	**16**	**80**

3) General Scheme for Distribution of Marks in Practical Examination in Microbiology

Marks: 100 [SEE: 50 Marks] [CIE: 50 Marks]

a) **Continuous Internal Evaluation (CIE): Fifty (50) marks:** Attendance in practical classes, seminar, assignment, quiz, participation in field tours, conferences, workshops, and the general behaviour in the department

Note: Total Marks of CIE will be 50 marks. A candidate must have to secure minimum 50% marks (i.e., 25 out of 50 marks). Failing so, he/she shall not be allowed to appear in End Semester Examination

b) **Semester End Examination (SEE):** Time: 5-6 h (Two days Examination)

Exercise-1	15 Marks	- Evaluated jointly by Internal and External Examiner
Exercise-2	15 Marks	- Evaluated jointly by Internal and External Examiner
Record	10 Marks	- Evaluated by Internal
Viva-Voce	10 Marks	- Evaluated by External
Total	**50 Marks**	

4) General Scheme for Distribution of Marks in Project Examination in Microbiology

The project work will carry total 100 marks (SEE=50 + CIE=50) in Semester III and 200 marks (SEE=100 + CIE=100) in Semester IV and will be evaluated by both external and internal examiners in the Department. The examiners will evaluate the project work considering the coverage of subject matter, presentation, literature etc.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Syllabus

for

Two year Post Graduate Programme

M. Sc. (Microbiology)

(As per NEP 2020 Structure Effective from 2023-2024)

M. Sc. Semester-I
Discipline Specific Core Course (DSC-1)-MICROBIOLOGY –Paper I
(MMI1T01) (MICROBIAL METABOLISM)

Course Outcomes: At the end of the course the students will be able to
1. Understand the biochemical basis of life forms
2. Learn the energy transformations in biological processes
3. Understand the synthesis of biomolecules
4. Understand synthesis and breakdown mechanisms in bacteria

DSC-1 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Carbohydrates and Lipids	Carbohydrates as informational molecules:-Sugar code, Plant Lectins: - ConA, GS4, WGA. Animal:- Galectin A, MBP-1.Viral:- HA, VPI. Bacterial:- LT,CT. Reverse TCA cycle, Biosynthesis of cell wall polysaccharides and bacterial peptidoglycan. Biosynthesis of microbial exopolysaccharides (alginate) Lipid:- Membrane lipids, biosynthesis of membrane phospholipids, Steroid transformation		**15 Hrs**
	Unit-II		
Proteins and Nucleic acids	**Proteins: C**haracteristics of alpha-helix and β-sheets. Ramachandran plot, Concept of protein domain and motif, common motifs and their role in metabolism, protein folding and denaturation curves, role of Chaperones and chaperonins. Biosynthesis of amino acids (only Aromatic, Acidic and Basic amino acid). Determination of primary structure of polypeptide (N-terminal, C-terminal determination, method of sequencing of peptides), **Nucleic acids:-** Structural details of Duplex DNA, Unusual structures: palindrome, inverted repeats, mirror repeats, triplet DNA, G tetraplex, secondary structure of RNA, purine and pyrimidine biosynthesis, degradation and regulation, salvage pathway, Inhibitors. DNA sequencing. (Maxam–Gilbert and Sanger dideoxy method)		**15 Hrs**

Unit III		
Photosynthesis	**Anoxygenic photosynthesis:-**Green sulphur bacterial, non-sulphur bacterial, purple phototrophic bacteria. **Oxygenic photosynthesis:-**Cyanobacteria. **Chemolithotrophy:-** Hydrogen oxidation and autotrophy in hydrogen bacteria. Oxidation of reduced sulphur compounds and Iron. **Bioluminiscence;** Biochemical pathway in bacteria	**15 Hrs**
Unit IV		
Nitrogen and Sulphur metabolism and methanogenesis	**Biochemical Mechanisms:** Nitrification and Anammox. Nitrate reduction and Denitrification. Nitrogen fixation: Symbiotic, nonsymbiotic. Sulphate reduction. Methanogenesis, Acetogenesis, Acetate use and autotrophy	**15 Hrs**

Suggested Books:

1. D. L. Nelson and M. M. Cox. 'Lehninger Principles of Biochemistry', Macmillan Int.

2. J. M. Berg, J. L. Tymoczko and L. Stryer. 'Biochemistry' 6 th edition, W. H Freeman and Company.

3. S. C. Rastogi. 'Biochemistry'. Tata McGraw Hill Publishing Company, New Delhi.

4. Gottschalk G. 'Bacterial Metabolism'. Springer, New York.

5. Doelle H.W. 1969. Bacterial Metabolism. Academic Press

6. Sandikar B. M. 'Basic Biochemistry and Microbial Metabolism'. Himalaya Publishing House, Mumbai.

7. Conn E. E. and Stmph P. K. 'Outlines of Biochemistry' John Wiley & Sons, New Delhi.

8. Sokatch JR. 1969. Bacterial Physiology and Metabolism. Academic Press

9. Brock Biology of Microorganisms, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street,San Francisco, CA 94111.

10. Voet D. and Voet J. G. (2011). Biochemistry. United Kingdom: Wiley.

M. Sc. Semester-I

Discipline Specific Core Course (DSC-2)-MICROBIOLOGY –Paper 2 (MMI1T02)

(ENZYMOLOGY AND TECHNIQUES)

Course Outcomes:

1. Students will be able to understand general characteristics of enzymes
2. Students will learn the different mechanisms of enzyme catalysis.
3. Students will be able to Gain an understanding of enzyme kinetics and regulation.
4. Students will be able to understanding the various biochemical techniques based on enzymes like biosensors

DSC-2 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Fundamentals of Enzymology	Concept of enzyme specificity, Mechanism of enzyme action: Models, catalysis by proximity effect, acid-base catalysis, electrostatic interaction, metal ion catalysis, nucleophilic and electrophilic catalysis, preferential binding. Mechanism of action of lysozyme and serine proteases. Multienzyme complexes; Concept and mechanism of fatty acid synthase and pyruvate dehydrogenase complexes Isoenzyme; concept and Lactate dehydrogenases as marker enzymes Enzyme regulation; Allosteric (example ATCase), chemical modification and calmodulin mediated regulation.		**15 Hrs**
	Unit-II		
Enzyme Kinetics	Significance of Michaelis-Menten equation and its transformations. kinetics of enzyme inhibition, Kinetics of bisubstrate reaction & multistep reactions Allosterism: Kinetic analysis of allosteric enzymes. Covalent Modification, Feed -back inhibition**.**		**15 Hrs**

Unit III		
Enzyme Techniques	Techniques for isolation and purification of enzymes, methods for enzyme assays. Protein: ligand binding studies: association and dissociation constants, co-operative ligand binding MWC or concerted model, sequential model. Enzyme biosensors: General concept, glucose biosensor. Industrial applications of enzymes (Amylase, Protease, Cellulase) Protein engineering- Objectives & strategies of enzyme engineering. Methods of enzyme engineering. Protein engineering applications.	**15 Hrs**
Unit IV		
Immobilised enzymes	Immobilization techniques for cells (physical adsorption, ionic binding, covalent binding, lattice entrapment, membrane entrapment, micro encapsulation) and enzymes (covalent binding, entrapment, micro encapsulation, cross-linking, adsorption, ionic binding, affinity binding, chelation, disulfide bonds) Immobilized enzyme kinetics, Immobilized bioreactors Applications of immobilized enzymes	**15 Hrs**

Suggested Books:

1) Fundamentals of Enzymology- Nicholas Price and Lewis Stevens, Oxford Univesrity press
2) Biochemistry -Albert L. Lehninger, Kalyani Publishers
3) Outlines of Biochemistry- Conn & Stumph
4) Enzymes & Enzyme Technology - Anilkumar, MV Learning
5) "Enzymology and Enzyme Technology" by Bhatt S M .
6) Enzyme Technology" by S Shanmugam and T Sathishkumar …
7) The Biochemistry of copper By: Jack Peisach, Phillip Aisen.
8) Metabolic Pathways By:-David M.Greenberg.
9) Harper's Biochemistry By: Robert K.Myrray.
10) Enzymes: By Trevor Palmer.
11) Methods in Enzymology By: S. Berger, A. Kimmel.
12) Immobilization of Enzymes and cells By: Gordon Bickerstaff.
13) Enzymes -Biotechnology Hand book-by NIIR Board of Consultants & Engineers
Asia Pacific Business Press Inc,106-E ,Kamla Nagar,Delhi-110007

M. Sc. Semester-I
Discipline Specific Elective Course (DSE-1)-MICROBIOLOGY- Paper 3 (MMI1T03) (ADVANCE TECHNIQUES IN MICROBIOLOGY)

Course outcome: At the end of the course the students will be able to

1. Learn the basic biophysical techniques
2. Understand the design and working principle of various microscopes
3. Understand the bimolecular separation and identification techniques
4. Learn the advanced molecular techniques

DSE-1 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Biophysical Techniques-I	Determination of size, shape and Molecular weight of Macromolecules:-by Viscosity, CD/ORD, Light scattering, diffusion sedimentation and Centrifugation techniques. X-ray crystallography: Principle, instrumentation and applications		**15 Hrs**
	Unit-II		
Biophysical Techniques-II	**Electrophoresis:** Agarose Gel, SDS-page, two-dimensional gel electrophoresis, capillary electrophoresis, immune-electrophoresis, Pulse field gel electrophoresis. **Chromatography**: Principle, instrumentation and applications of GLC, GC-MS and HPLC		**15 Hrs**
	Unit III		
Biophysical technique III	Blotting techniques: Western, Southern, Northern, Radioimmunoassay. NMR and its biological importance. Infrared spectroscopy, FTIR Spectroscopy and its application. Radiography : Basic concept, Autoradiography		**15 Hrs**
	Unit IV		
Microscopical Techniques.	Electron Microscopy: SEM, TEM, Staining procedures and microscopy. Fluorescent Microscopy: Staining procedures and Microscopy, FISH. Laser scanning, confocal microscopy, Atomic force microscopy. Cryoelectron microscopy.		**15 Hrs**

Suggested Books:

1. Biophysical Chemistry by Upadhyay, Upadhyay, Nath
2. Boyer R. F. (2000). Modern experimental biochemistry. India: Pearson Education.
3. Chakravarty R., Goel S. and Cai W. (2014). Nanobody: the "magic bullet" for molecular imaging? Theranostics. 4(4): 386-398.doi:10.7150/thno.8006
4. Dennison C. (2013). A guide to protein isolation. Netherlands: Springer Netherlands.
5. Desiderio D. M., Kraj A. and Nibbering N. M. (2009). Mass spectrometry: instrumentation, interpretation and applications. United Kingdom:Wiley.
6. Feldheim D. L. and Foss C. A., Jr. (Editors). (2002) Metal nanoparticles synthesis and characterization and applications. Taylor &Francis
7. Hofmann A., Walker J. M., Wilson K. and Clokie S. (2018). Wilson and Walker's Principles and techniques of biochemistry and molecular biology. United Kingdom: Cambridge University Press.
8. Narayanan P. (2007). Essentials of biophysics. India: New Age International.
9. Nölting B. (2013). Methods in modern biophysics. Germany: Springer Berlin Heidelberg.
10. Rutherford T. (2019). Principles of analytical biochemistry. Alexis Press LLC. New York.
11. Segel I. H. (2010). Biochemical calculations. 2nd Edition. India: Wiley India Private. Limited.

M. Sc. Semester-I
Discipline Specific Elective Course (DSE-1)-MICROBIOLOGY- Paper 3 (MMI1T03) (MEMBRANE STRUCTURE AND SIGNAL TRANSDUCTION)

Course Outcome:

1. Students will understand the structures and components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. Students will understand how the transport of molecules through cell membrane.
3. Students will understand different advance technique used for cell membrane study.

At the end of the course, the student has a strong foundation on the functions of the cell.

DSE-1 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Structure and organization of membranes	Prokaryotic and Eukaryotic Cell structure, Structure and function of Mitochondria, and Endoplasmic reticulum, prokaryotic membrane, Membrane junctions (Gap & tight junctions), Techniques for membrane study: Electron microscopic method, membrane vesicles, differential scanning colorimetry, flouroscence, photo bleaching recovery, flow cytometry		**15 Hrs**
	Unit-II		
Membrane Transport	Active and Passive transport, Uniport, ATP powered pumps, non-gated ion channels, co transport by symporters and antiporters, transepithelial transport.		**15 Hrs**
	Unit III		
Signal Transduction	General concept of cell signaling, G-protein coupled receptors and their effectors. RTK and MAP Kinases-Down regulations of pathways. Cytokine receptors and their mechanism (JAK-STAT pathway).		**15 Hrs**
	Unit IV		
Bacterial signal transduction	Basic two component system. Histidine kinase pathway. Sporulation as a model of bacterial signaltransduction. Osmoregulatory pathways. Heat shock proteins. Mating types of yeast. Bacterial Biofilm: Composition, formation and role.		**15 Hrs**

Suggested Books:

1. Principles of Biochemistry, A. L. Lehninger, D.L. Nelson, M.M. Cox. , Worth Publishing.
2. Harper's Biochemistry K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell,McGraw Hill/ Appleton and Lange.
3. Biochemistry (Fifth Edition), Lubert Stryer.
4. V. Voet and J. G. Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.
5. Molecular Cell Biology by Bruce Albert.
6. Molecular Biology by Lodish, Darnell and Baltimore.
7. Molecular Biology of the gene by Watson et al 4th ed.
8. Cell and molecular biology by Gerald Karp.
9. Cell biology by Pollard and Earnshaw

M. Sc. Semester-I
MICROBIOLOGY - Paper-4 (MMI1T04)
(RESEARCH METHODOLOGY)

Course Outcomes:

After learning research methodology course, students will be able to

1. Identify and describe the characteristics of different types of research, including basic, applied, and patent-oriented research.
2. Apply scientific thinking and problem identification techniques in the research process.
3. Apply descriptive and inferential statistical analysis techniques to analyze and interpret research data and understand the concept of hypothesis and its importance in research, and apply appropriate research methods.
4. Develop skills in technical writing, research reporting, and the proper structure and organization of research documents and gain awareness of research ethics, academic integrity, and the importance of avoiding plagiarism and academic malpractice.

RM-THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Research basics & objectives	1.1 Definitions; research, research methodology, discovery, invention & innovation. 1.2 General & specific characteristics of research. Types of research- Descriptive & analytical, Applied & fundamental, Qualitative & quantitative, Conceptual and empirical. 1.3 Steps of action- Genesis of problem, defining of problem & formulation of the problem. 1.4 Literature survey- Importance of literature survey in defining the problem-Primary & secondary sources-reviews , monographs, patents, web as a source of literature. 1.5 Identifying gaps in present knowledge. Research questions & development of working hypothesis.		**15 Hrs**

Unit-II		
Research Design	**2.1** Features of good research **2.2** Definition of hypothesis, assumption, postulates. Qualities of good hypothesis, Null Hypothesis and Alternative Hypothesis **2.3** Definition & types research methods, characteristics of survey methods their types & advantages. **2.4** Experimental method- definition, basic assumption, types of variables in experiment. Steps of experimental method.	**15 Hrs**
Unit III		
Bio-statistics & its application in research	**3.1** Definition of statistics & bio-statistics, population & types of population, individual, attribute, variate, frequency & frequency distribution, class interval, methods of grouping or class interval, class width & boundary, Accuracy and Precision. **3.2** Methods of data collection-Sampling , sampling errors, non sampling errors **3.3** Central tendency & measures of central tendency- mode, median, arithmetic mean of grouped & ungrouped data geometric mean, harmonic mean. **3.4** Measures of variance or dispersion- standard deviation or root mean deviation **3.5** Test of comparision - Chi square test, Student's t-test. **3.6** Correlation analysis. Linear regression. **3.7** Introduction to ANOVA, Use of statistical software. Application of Microsoft Excel in statistical analysis (statistical functions and spreadsheets in MS-Excel). **3.8** Presentation of statistical data- Tables , Charts (bar charts, pie charts) & diagrams (histograms & dendrogram) & diagrams (bar charts, pie charts, histograms & dendrograms)	**15 Hrs**

Unit IV		
Technical, and research reporting, research ethics and plagiarism	**4.1** Research report-Concept and need of research report and scientific writing. Structure of thesis, structure of project report, structure of project proposal. Importance of abbreviations and acronyms. Significance of report writing . **4.2** Structure of Research paper, Types of scientific publications- magazines, journals, reviews, news-letters, various reference styles. Annotated bibliographies. **4.3** Academic integrity (Research Ethics), skills (rules) for good academic practice, understanding plagiarism and academic malpractice/ Copy write, plagiarism checker. **4.4** Impact Factor, Cite Score, *h*-Index, i10-Index, Citation Index. **4.5** Intellectual Property Rights (IPR) Introduction to IPR (Patents, Trademarks, Geographical indicators, and Copyright). **4.6** Online research tools; N-list, Zotero /Mendley, and Software for paper formatting like LaTeX tools; N-list, Mendley, plagiarism checker and LaTeX.	**15 Hrs**

Suggested Books:

1. Shanti Mishra, & Alok, S. (2011). *Handbook of Research Methodology: A Compendium for Scholars & Researchers*. Educreation Publishing.
2. Singh, Y. kumar. (2006). *Fundamentals of Research Methodology and Statistics*. New Age International Publishers.
3. Walliman, N. (2010). *Research Methods The Basics*. Routledge Taylor and Francis Group.

M. Sc. Semester-I

MICROBIOLOGY – PRACTICAL-1 (MMI1P01)

Course outcomes:

1.This course explains the enzyme activity determination of important hydrolytic enzymes.
2. Students will earn about the effect of different physical factors.
3. Students will able to isolate and purify the enzyme.
4. Students will able to isolate and identify Nitrogen fixing bacteria.
5. Students will be able to isolate Siderophore producing bacteria.

LAB-1	**Hours: 06 Hours /Week**	**Marks: 50+50=100**	**Credit: 03**
	Perform minimum 08 from following practical's		
	1) Detection of Urease enzyme activity, 2) Determination of kinetic constant of amylase: -Amylase activity, Vmax. Km. 3) Effect of pH and temperature on amylase activity. 4) Effect of inhibitors on amylase activity. 5) Estimation of protein by Lowry's method. 6) Production, isolation and purification of enzyme and determination of its activity. (any one enzyme) 7) Estimation of sucrose in presence of glucose. 8) Determination of UV absorption maxima of proteins, DNA and RNA. 9) Isolation of Siderophore producing bacteria. 10) Determination nitrate reduction and denitrification of microorganism 11) Determination of blood sugar by using glucose biosensor. 12) Titration curve of amino acid and determination of pK value. 13) Immobilization of enzyme and estimation of its activity.		**45 Hrs**

M. Sc. Semester-I
MICROBIOLOGY – PRACTICAL-2 (MMI1P02)

Course outcomes: After successful completion of this course, students will be able :

1. This course explains the techniques of protein biology
2. Students will learn about Subcellular organelles and isolation of Marker enzymes.
3. The performance of various molecular techniques will be understood
4. Students will learn various techniques of protein isolation and analysis techniques
5. Students will learn about techniques for Isolation and screening of industrially important microorganisms
6. Students will learn about statistical analysis of research data

LAB-2	Hours: 06 Hours /Week	Marks: 50+50=100	Credit: 03

Perform minimum 10 from following practical's and Experiment number 15, 16 and 17 are compulsory

	1) Separation of DNA by agarose gel electrophoresis 2) Separation of amino acids/sugars by paper chromatography. 3) Separation of serum proteins by paper electrophoresis. 4) Separation of amino acids by Thin layer chromatography. 5) SDS-Page of proteins. 6) Performance of affinity chromatography. 7) Performance of Gel filtration chromatography. 8) Demonstration of blotting technique [Western /Southern/Northern]. 9) Ion exchange chromatography 10) Separation of Subcellular organelles and isolation of Marker enzymes 11) Demonstration of HPLC and GC. 12) Isolation and screening of industrially important microorganisms. 13) Determination of thermal death point and thermal death time of microorganisms. 14) Measurement of bacterial population by turbidometry method 15) Determination of Statistical averages / central tendencies. a) Arithmetic mean b) Median c) Mode.	**45 Hrs**

	16) Representation of Statistical data by a) Histograms b) Pie diagrams c) Use of statistical software (SPSS). 17) Determination of measures of Dispersion a) Mean deviation b) Standard deviation and coefficient of variation. 18) Tests of Significance-Application of following a) ChiSquare test b) t-test c) Standard error 19) Determination and interpretation of data by one and two way ANOVA.	

Suggested Books for Lab 1 & 2:

1) Microbes in Action: Seely, Wander Mark Tarporewala, Bombay

2) A Manual of Microbiology: A.J. Salle.

3) Microbiology Methods: Collins

4) Bacteriological Techniques: F.J.Baker

5) Introduction to Microbial Techniques: Gunasekaran

6) Biochemical methods: Sadashivam & Manickam

7) Laboratory Fundamentals of Microbiology: Alcamo, I.E., Jones and Bartlett Publishers

8) Biochemical techniques by Wilson and Walker.

9) Experimental Biochemistry by B. Sashidhar Rao and Vijay M. Deshpande.

10) Practical Biochemistry by David Plummer

11) An Introduction to Practical Biochemistry, 3rd Edition, Plummer D.T

12) Experiments in Microbiology, 4th Ed., Aneja K.R.

13) Handbook of Techniques in Microbiology, Karwa A S., Rai, MK and Singh HB

14) Methods in Enzymology By: S.Berger, A. Kimmel.

15) Laboratory Manual on Biotechnology-P. M. Swamy

16) Essentials of biostatistics & research methodology by Indranil, Saha, Bobby Paul.

M. Sc. Semester-II
Discipline Specific Core Course (DSC-3)-MICROBIOLOGY –Paper 5 (MMI2T05) (ENVIRONMENTAL MICROBIAL TECHNOLOGY)

Course Outcomes:

1. Be able to acquaint with microbial communities and their interaction.
2. Be able to know about role of microorganisms in treatment of waste materials.
3. Be able to know about the factors responsible for global warming.
4. Be able to know about restoration of degraded ecosystem.

DSC-3 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Biodeterioration, Biomagnification and Eutrophication	Biodeterioration: Definition and concept of biodeterioration, biodeterioration of woods, textile clothing and pharmaceutical products. Biodeterioration of stone monuments and approach for its restoration. Biomagnification: concept and consequences, Biomagnifications of heavy metals, chlorinated hydrocarbons and pesticides and mitigation methods. Eutrophication: Consequences of . waste water and sewage discharge in natural water bodies, Causes of eutrophication, Microbial changes induced by discharge of organic and inorganic pollutants, factors influencing eutrophication process and control of eutrophication.		**15 Hrs**
	Unit-II		
Biotransformation, Biodegradation and Bioleaching	Biotransformations: Mechanism of biotransformation, Metals and metalloids, mercury, pesticides such as hexachlorobenzene and DDT transformations. Biodegradation: Biodegradation of plastics, lignin, aliphatic, aromatic and asphalts hydrocarbons. Bioleaching of ores, leaching techniques and applications.		**15 Hrs**
	Unit III		
Restoration of degraded ecosystems	Concept of Reclamation, revegetation, Management of mine spoil dumps and tailing sites, Wastewater management using high rate transpiration systems, Concept of phytoremediation and applications. Case studies related to restoration of wasteland ecosystems using integrated biotechnological approach.		**15 Hrs**

Unit IV		
Global Environmental Problems	Global warming and climate change, Ozone depletion, UV-B, green house effect, acid rain, their impact and biotechnological approaches for management. Acid mine drainage and associated problems.	**15 Hrs**

Suggested Books:

1. Application of Microbes in Environmental and Microbial Biotechnology. Editors: Inamuddin, Mohd Imran, Ahamed, Ram Prasad, Copyright: 2022

2. Recent Advances in Microbial Degradation. Editors: Inamuddin, Mohd Imran Ahamed, Ram Prasad, Copyright: 2021

3. Environmental Pollution and Remediation, Editors: Ram Prasad Copyright: 2021

4. Advances in the Domain of Environmental Biotechnology

5. Recent Developments in Microbial Technologies. Editors: Ram Prasad, Vivek Kumar, Joginder Singh, Chandrama Prakash Upadhyaya, Copyright: 2021

6. Microbial Technology For Sustainable Environment Editors: Pankaj Bhatt, Saurabh Gangola, Dhanushka Udayanga, Govind Kumar

7. Microbial Ecology: Fundamentals and Applications (4th Edition) **Author:** Ronald M. Atlas, Richard Bartha

8. Brock Biology of Microorganisms (14th Edition) **Author:** Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock

9. Environmental Microbiology 3rd Edition **Author:** Ian L. Pepper, Charles P. Gerba, Terry J. Gentry

10. Soil Microbiology 3rd Edition **Author:** Robert L. Tate III

11. Environmental Microbiology: From Genomes to Biogeochemistry 2nd Edition **Author:** Eugene L. Madsen

12. Manual of Environmental Microbiology **Author:** Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai

M. Sc. Semester-II
Discipline Specific Core Course (DSC-4)-MICROBIOLOGY –Paper 6 (MMI2T06) (IMMUNOLOGY AND IMMUNODIAGNOSTICS)

Course outcome:

1. This course gives an overview on the immune system including organs, cells and receptors
2. The students learn about molecular basis of antigen recognition, hypersensitivity reaction, antigen-antibody reactions.
3. The course develops in the student an appreciation for principles of immunology andits applications in treating human diseases.

DSC-4 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Overview of the Immune system and CMI	Cells involved in Immune system: Hematopoiesis, Lymphocytes, mononuclear phagocytes, Antigen Presenting cells, Granulocytes. Lymphoid organ: Lymphatic system, Primary and Secondary lymphoid organs. Complement System: Pathways of complement activation, regulation of complement system, Biological functions of complement system. Inflammation: Intracellular cell adhesion molecules, Mechanism of cell migration, Inflammation. Pathways of antigen processing and presentation. Cell Mediated Immunity: General properties of effector T cells, Cytotoxic T Cells, Natural Killer cells, Antibody-Dependent cell mediated cytotoxicity. T-Cell dependent and T-cell independent defense mechanisms.		**15 Hrs**
	Unit-II		
Specific Immune Response	Cancer and the Immune system: Origin and Terminology, Malignant Transformation of cells, oncogenes and cancer induction, Tumor Antigens, Immune surveillance theory, Tumor evasion of theImmune system, Cancer Immunotherapy. Transplantation Immunology: Immunological basis of Graft Rejection, Mechanism of Graft rejection. Immunosuppressive therapy: General and specific. Clinical Transplant. Tolerance: Central and peripheral tolerance to self antigens, Mechanism of induction of natural tolerance.		**15 Hrs**

Unit III		
Immune Dysfunction	Immunodeficiency disorders:- Phagocytic cell defect (Chediak-Higashi syndrome); B-cell deficiency (Bruton's X-linked hypogammaglobulinemia); T-cell deficiency disorder (DiGeorge Syndrome); Combined B-cell & T-cell deficiency disorder (SCID-Severe combined immunodeficiency diseases, Wiskott-Aldrich syndrome); Complement deficiencies and secondary immunodeficiency conditions carried by drugs, nutritional factors & AIDS. Autoimmunity and autoimmune diseases:-General consideration, Etiology, Clinical categories, Diagnosis and treatment. RA (Rheumatoid arthritis); SLE (Systemic Lupus Erythematosus); Guillain-Barre Syndrome; Multiple sclerosis; Mysthenia gravis; Grave's disease; Goodpasture syndrome, Autoimmune haemolytic disease; Pernicious anaemia. Hypersensitivity :- Type I, Type II, Type III & Type IV	**15 Hrs**
Unit IV		
Immuno-diagnostics	Precipitation reactions: Immunodiffusion, immunoelectrophoresis, Agglutination reactions: Bacterial Agglutination, Heamagglutination, Passive agglutination, Reverse passive agglutination and agglutination inhibition. Immunodiagnostic techniques: Radio-Immuno assay, ELISA, Chemiluminiscence immunoassay, Western blotting technique, Complement fixation test, Immunofluorescence, Immunoelectron microscopy.	**15 Hrs**

Suggested Books:

1. Essentials of Immunology by Riott I .M. 1998. ELBS, Blackwell Scientific Publishers, London.
2. Immunology 2nd Edition by Kuby J. 1994. W.H. Freeman and Co. New York.
3. Immunology - Understanding of Immune System by Claus D. Elgert. 1996. Wiley -Liss, New York.
4. Fundamentals of Immunology by William Paul.
5. Cellular and Molecular Immunology. 3rd Edition by Abbas.
6. Immunobiology: The Immune System in Health and Disease. 3rd Edition by Travers.
7. Immunology- A short Course. 2nd Edition by Benjamin.
8. Manual of Clinical Laboratory and Immunology 6th Edition. 2002 by Noel R. Rose, Chief Editor: Robert G. Hamilton and Barbara Detrick (Eds.), ASM Publications.
9. Pocket Guide to Clinical Microbiology. 2nd Edition. 1998 by Patrick R. Murray, ASM Publications.
10. Immunology, 6th Edition Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne, Freeman, 2002.
11. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.
12. Fundamental of Immunology, Paul, 4th edition, Lippencott Raven, 1999.
13. Monoclonal antibodies Goding, , Academic Press. 1985.

M. Sc. Semester-II
Discipline Specific Elective Course (DSE-2)-MICROBIOLOGY- Paper 7 (MMI1T03) (MICROBIAL METABOLITES)

Course Outcomes

1. Acquaint with basics of microbial metabolites, newer bioactive molecules and Immunomodulators.
2. Understand structure and mode of action of secondary metabolites. Knows the concept of Quorum sensing.

DSE-2 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Introduction of metabolites	Metabolites: General account of metabolites, secondary metabolites. Classification, structure and mode of action of secondary metabolites. Plants secondary metabolites: Digitoxine, Salicylic acid, Mycotoxins- Aflatoxin, Ochratoxin, Patulin. Biopolymers: Polypeptides (collagen, casein and serum albumin), Polynucleotides and polysaccharides (amylose, amylopectin, alginate, cellulose) and other biopolymers like chitin, Xanthan, dextrin, Gellan, Pullulan, curdlan and hyluronic acid. Polyamines: Brief outline and functions of polyamines. Synthesis of linear polyamine-putrescine, cadoverine, spermidine and spermine. Secondary Metabolite Production by Cyanobacteria, Enzyme inhibitors and Immunomodulators		**15 Hrs**
	Unit-II		
Antimicrobial drugs: Secondary metabolites	Antibiotics: History and discovery of antibiotics, Antibiotic resistance, Mechanisms of antibiotic resistance. Structure and mode of action of antibiotics: Aminoglycosides (Amikacin), Carbapenems (Imipenim), Microlids (Azithromycin), Nitrofuran (Nitrofurantoin), Penicillin (Amoxicillin), Quinolones (Gatifloxacin /Ciprofloxacin), Sulphonamides (Sulfamethoxazole), Tetracyclines (Doxycyclines), Chloramphenicol, Fucanazole. New Molecules- Angucyclines (baikalomycins A–C), rabelomycin and 5-hydroxy-rabelomycin		**15 Hrs**

Unit III		
Pigments as metabolites	General account of pigments. Microbial pigments: Bacteriochlorophylls, Carotenoids of prokaryotes, rhodopsin and accessory pigments (Pulcherrimin and indigoidin) Defensive role of pigments. Vaso-relaxants or contractants, Diuretics or laxatives Marine bacteria synthetizing bio-pigment- prodigiosin, astaxanthin, violacein, zeaxanthin, lutein or lycopene Industrial Importance of Pigmented Compounds	**15 Hrs**
Unit IV		
Microbial vitamins	Antioxidants. Characteristics of fats and water soluble vitamins. Structure, function and chemistry of: Retinol (vitamin A), Riboflavin (vitamin B2), Cynocobalamine(Vitamin B12) and ascorbic acid (vitamin C). Deficiency diseases in humans:Xerophthalmia, BeriBeri, Pellegra, Scurvey, Keratomalacia, osteoporosis, Osteomalacia, Cheilosis,Glossitis, Pernicious anemia and Erythroid hypoplassia.	**15 Hrs**

Suggested Books:

1. General Microbiology by Hans G. Schlegel, C. Zaborosch. Publisher: Cambridge University Press
2. Biotechnology. A Textbook of Industrial Microbiology, by W. Crueger and A. Crueger.
3. Publisher :Sinauer Associates.
4. Industrial microbiology by G. Reed, Publishers: CBS
5. Biology of Industrial microorganisms By A. L. Demain.
6. Stanbury P.F.A. Whitaker and Hall. Principles of fermentation technology
7. Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment by H.C. Vogel, C.L. Todaro, C.C. Todaro. Publisher: Noyes Data Corporation/ Noyes Publications.
8. New Products and New Areas of Bioprocess Engineering (Advances in Biochemical
9. Engineering/Biotechnology, 68) by T. Scheper. Publisher : Springer Verlag. New and Future Developments in Microbial Biotechnology and Bioengineering: Microbial Secondary Metabolites Biochemistry and Applications byVijai G. Gupta (editor), Anita Pandey (editor)
10. Biotechnology of Antibiotics and Other Bioactive Microbial Metabolites by Giancarlo Lancini, Rolando Lorenzetti
11. Bacterial physiology and metabolism by Kim B.H. and Gadd G.M. 2008. Publisher: Cambridge University Press, Cambridge.

M. Sc. Semester-II
Discipline Specific Elective Course (DSE-2)-MICROBIOLOGY- Paper 7 (MMI2T07) (PHARMACEUTICAL MICROBIOLOGY)

Course Outcomes:

1) Students will gain the knowledge regarding Drug discovery and drug development

2) Students will get knowledge about production of various types of enzymes antibiotic resistance and development of new therapeutic drugs to the students.

3) Students will have a deep insight into the antimicrobial agents and their mode of action.

4) Students get knowledge about Regulatory practices, biosensors applications in Pharmaceuticals and Quality Assurance

DSE-2 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Introduction to Chemotherapeutic agents	History and development of chemotherapeutic agent, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semisynthetic, Natural Antibiotics Antimicrobial agents: antibacterial, antifungal, antiviral, antiprotozoal and anti cancer antibiotics and drugs and their mode of action.		**15 Hrs**
	Unit-II		
Preservation, Antibiotic resistance and development of new therapeutics	Principles of preservation: objectives of preservation, the ideal preservative, rational development of a product preservative system etc. Preservative stability and efficacy. methods of Preservative evaluation and testing Development of antibiotic resistance, Mechanism of antibiotic resistance, Antimicrobial Peptides: History, properties, sources, mode ofaction, application. Phage therapy: introduction to phages, lytic cycle, types of phages involved in phage therapy Plant based therapeutic agents		**15 Hrs**
	Unit III		
Microbial production and Spoilage of pharmaceutical Products	Microbial contamination and spoilage of pharmaceutical products (sterile injectibles non injectibles, ophthalmic preparations and implants) and their sterilization. Manufacturing procedures and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (streptokinase,streptodornase), New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials		**15 Hrs**

Unit IV		
Regulatory practices, biosensors applications in Pharmaceuticals and Quality Assurance	Introduction to pharmacopoeia: Food and Drug Administration (FDA) regulation and Indian Pharmacopoeia (IP), British Pharmacopoeia (BP), United States Pharmacopoeia(USP) Good Laboratory Practices (GLP) Good Manufacturing Practices (GMP) and Current Good Manufacturing Practices (cGMP), Government regulatory practices and policies, FDA perspective. Rational drug design. Biosensors in pharmaceuticals Application of microbial enzymes in pharmaceuticals. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization) Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory) Safety in Microbiology laboratory.	**15 Hrs**

Suggested Books:

1. Pharmaceutical Microbiology – Edt. byW.B.Hugo&A.D.Russell Sixth edition. Blackwell scientific Publications.
2. Analytical Microbiology –Edt by Frederick Kavanagh Volume I & II.Academic Press New York.
3. Prescott's Microbiology 8th Edition by Willey, Joanne, Sherwood, Linda, Woolverton, Chris
4. Pharmaceutical Microbiology by AshutoshKar
5. Quinolinone antimicrobial agents – Edt. by David C. Hooper, JohnS.Wolfson .ASM Washington DC.
6. Quality control in the Pharmaceutical Industry - Edt. by Murray S.Cooper Vol.2. Academic Press New York.
7. Biotechnology – Edt. By H.J.Rehm &G.Reed, Vol 4. VCH Publications, Federal Republic of Germany.
8. Pharmaceutical Biotechnology by S.P.Vyas &V. K. Dixit. CBS Publishers& Distributors, New Delhi.
9. Good Manufacturing Practices for Pharmaceuticals Second Edition, by Sydney H.Willig, Murray M.Tuckerman, William S.Hitchings IV. Mercel Dekker NC New York.
10. Advances in Applied Biotechnology Series Vol 10, Biopharmaceuticals in transition. Industrial Biotechnology Association by Paine Webber.Gulf Publishing Company Houston.
11. Drug Carriers in biology & Medicine Edt. by Gregory Gregoriadis.Academic Press New York.
12. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan lalIhhpunjani. CBS Publishers & Distributors, New Delhi.

M. Sc. Semester-II
MICROBIOLOGY – PRACTICAL-3 (MMI2P03)

Course Outcomes:

1. Be able to perform techniques in environmental microbiology
2. Be able to understand different parameters in environment microbiology

LAB-3	Hours: 06 Hours /Week	Marks: 50+50=100	Credit: 03
Perform minimum 10 from following practical's			
	1. Determination of Colour, Turbidity, temperature as physical characteristics of water and sewage 2. Determination of pH, alkalinity and acidity of water and sewage 3. Determination of total solids of waste water. 4. Determination of hardness of sewage, oil and grease. 5. Determination of oil and grease contents in water and sewage 6. Determination of Dissolve oxygen in sewage 7. Determination of Chemical Oxygen Demand in sewage. 8. Determination of nitrate nitrogen in water and sewage by UV - spectrophotometric method 9. Determination of the concentration of sulphate in water and sewage by using turbidometric method, 10. Determination of the concentration of chloride in water and sewage by Mohr's titrimetric method, 11. Determination of the concentration of phosphorus in water and sewage by stannous chloride method 12. Sample (water and sewage) preparation for metal analysis, 13. Determination of the concentration of mercury in water and sewage by spectrophotometric method, 14. Determination of the concentration of lead in water and sewage by spectrophotometric method, 15. Determination of the concentration of copper in water and sewage by spectrophotometric method 16. Determination of Microbiological characteristics of water and sewage 17. Determination of Microbiological analysis of soil: 18. Screening of antibiotic producing microorganism from soil, 19. To demonstrate ammonification process in soil 20.To demonstrate nitrification process in soil 21. To demonstrate denitrification process in soil	**45 Hrs**

Suggested Books:

1. Environmental Science and Biotechnology by A. G. Murugesan and C. Rajkumari ISBN 10: 8180940098 / ISBN 13: 9788180940095 Editorial: MJP Pub, Chennai, 2005
2. Practical Manual of Wastewater by Barbara Hauser CRC Press 2019
3. Standard Methods for the Examination of Water and Wastewater, 24th edition APHA AWWA, 2023.
4. Handbook Of Water And Wastewater Analysis Hardcover – 1 January 2007 by Kanwaljit Kaur

5. Handbook of Methods in Environmental Studies: Water and Waste Water Analysis by S.K. Maiti, Oxford Book Company 2011
6. Water and Wastewater Laboratory Techniues by Roy- Keith Smith Water Environment Federation, Second Edition.
7. Industrial Water Analysis Handbook Author: Natarajan Manivasakam, Chemical Publishing Book 2011
8. Methods of Soil Analysis, Part 2: Microbiological and Biochemical Properties: 12 (SSSA Book Series) by Peter J. Bottomley, J. Scott Angle, R. W. Weaver, 2014

10. Soil Microbiology, Ecology, and Biochemistry by Paul and Clark, 1989

11. Advanced Techniques in Soil Microbiology by Ajit Varma and Ralf Oelmuller 2007 Springer Publication

M. Sc. Semester-II
MICROBIOLOGY – PRACTICAL-4 (MMI2P04)

Course Outcomes:

1. Be able perform various diagnostic technique in immunology.
2. Be able to gain knowledge of different bacterial diseases and their diagnosis

LAB-4	**Hours: 06 Hours /Week**	**Marks: 50+50=100**	**Credit: 03**
Perform minimum 10 from following practical's			
	1) Determination of concentration of antigen in the serum sample by Immunodiffusion technique 2) Perfromance of Immunoelectrophoresis technique to separate immunoglobulins 3) Determination of Blood grouping and Rh type 4) Detection of typhoid antigen using Widal [slide and tube] tests. 5) Detection of Syphilis using TRUST [Toludine Red Unheated Serum Test] 6) Performance of Australian latex antigen test. 7) Performance of Antistreptolysin 'O'test [ASO] 8) Performance of Pregnancy test. 9) Performance of Rheumatoid arthritis test [RA] 10) Detection for the presence of antibodies to Syphilis by RPR [rapid plasma reagin] test. 11) Performance of *Treponema pallidum* haemagglutination test (TPHA). 12) One step test for Qualitative detection of HBs. 13) ELISA [Enzyme Linked Immunosorbent Assay]-HIV and HBs. 14) Serological detection of tuberculosis by Quanti FERON – TB Gold test 15) Isolation & Identification of Rosettee cells. 16) Total and Differential counting of WBC.		**45 Hrs**

Suggested Books:

1. Hudson, L. and Hay, F.C. (1989). Practical Immunology. 3rd Edition, Blackwell scientific Publications, Oxford.
2. Myers, R.L. (1989). Immunology: A Laboratory Manual. Wm. C.Brown Publishers. Dubuque, Lowa.
3. Rastogi, S.C. (1996). Immunodiagnostics Principles and Practice. New Age International (P) Ltd., New Delhi.
4. Talwar, G.P. (1983). A Hand Book of Practical Immunology. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Talwar, G.P. and Gupta, S.K. (1992). A Hand Book of Practical and Clinical Immunology. Vol. 1 - 2. CBS Publishers & Distributors, Delhi.
6. Turgeon, M.L. (1990). Immunology and Serology in Laboratory Medicine. The C.V. Mosby Company, Baltimore.
7. Frank C. Hay, Olwyn M. R. Westwood (2008) Practical Immunology, 4th Edition Wiley-Blackwell Publisher
8. Ray Edwards (1999) Immunodiagnostic –A Practical Approach by Oxford University Press
9. *Imunodiagnostics* Principles and *Practice*. A Hand *Book* of *Practical* and Clinical *Immunology*. Vol. 1 -2 , New Age International (P) Ltd.
10. Garvey, J.S., Cremer, N.E. and Sussdorf, D.H. (1977). Methods in Immunology. A Laboratory Text for Instruction and Research. 3rd Edition. The Benjamin Cummings Publishing Company Advanced Book Program, London.
11. Praful B. Godkar (Author), Darshan P. Godkar (2018) Textbook Of Medical Laboratory Technology Clinical Laboratory Science And Molecular Diagnosis 2 Vol Set, 3rd Ed Bhalani Publishing House

M. Sc. Semester-III
Discipline Specific Core Course (DSC-5) -MICROBIOLOGY- Paper 8
(MMI3T08) (MICROBIAL DIVERSITY, EVOLUTION AND ECOLOGY)

Course Outcomes

1. Students should gain understanding of major concepts in microbial ecology.
2. Students will understand contemporary techniques used to analyze microbial communities and community function.
3. Students should understand microbial evolution and ecosystem management.

DSC-5 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Study of microbial diversity	Distribution, Abundance, Ecological Niches. Types-Bacterial, Archael, Eucaryal, Characteristics and Classification of Archae Thermophiles classification, habitat and thermophilic adaptations. Commercial aspects of thermophiles and application of thermoenzymes. Acidophiles- Classification, life at low pH, acido-tolerance, applications. Alkaliphiles- Isolation, habitat distribution and taxonomy, Enzymes of alkaliphiles and their applications. Psychrophiles- Microbial diversity at cold ecosystem, cold sensing, cold adapted enzymes, cryoprotectants and ice binding proteins, role of exopolymers in microbial adaptations to sea ice. Halophiles- Classification, Halophilicity and Osmotic protection, Hypersaline Environments, Prokaryotic halophiles: Halobacteria – osmo-adaptations or halotolerance mechanism, Applications of halophiles and their extremozymes. Barophiles- Classification, high pressure habitat adaptation to high pressure, life under pressure, applications of barophiles.		**15 Hrs**

Unit-II		
Methods of studying microbial diversity	Introduction to Species richness, Total number of species, Species evenness and Distribution of species. Methods of biodiversity analysis: Biochemical Methods -1. Plate Count: Selective plating & Direct viable counts 2. Community physiological profiling (CLPP) 3. Fatty acid methyl ester analysis (FAME), advantages & disadvantages of biochemical methods. Molecular based methods : 1. G+C content 2. Nucleic acid re-association and hybridization 3. DNA Microarrays 4. DNA Cloning & Sequencing 5. PCR-based methods DGGE/TGGE, Single strand conformation polymorphism (SSCP), Restriction fragment length polylymorphism (RFLP), Terminal restriction fragment length polymorphism (T-RFLP) Ribosomal intergenic spacer analysis (RISA) / Automated ribosomal intergenic spacer analysis (ARISA). Highly repeated sequence characterization or microsatellite regions, advantages & disadvantages of molecular methods. Study of Diversity indices, dominance indices, information statistics indices, Shannon index, Brillouin Index, Rank abundance diagrams, community similarity analysis, Jaccard Coefficient, Sorensen coefficient, cluster analysis.	**15 Hrs**
Unit III		
Study of Microbial Evolution	Evolution of earth and early life forms. Primitive life forms:-RNA world, molecular coding, energy and carbon metabolism, origin of Eukaryotes, endosymbiosis. Methods for determining evolutionary relationships:-Evolutionary chronometers, Ribosomal RNA sequencing, signature sequences, phyllogenetic probes, microbial community analysis. Derivation of Microbial Phyllogeny:-characteristics of domain of life, classical taxonomy, chemotaxonomy, bacterial speciation. Genetic structure of population:-Genotype frequency, allele frequencies. Hardy-Weinberg Law: -Assumptions, predictions, derivation, extension and natural selection.	**15 Hrs**

Unit IV		
Microbial Interactions and Ecosystem Management	Population, guilds, communities, homeostatis, Environment and microenvironment. . Terrestrial environment, deep, surface ecosystems. Fresh water environment, lake and river microbiology. Marine Microbiology and Hydrothermal vents. Microbial Interactions: Competition and coexistence, Gause hypothesis, syntrophy, commensalism and Mutualism, predation, parasitism, and antagonism, Interaction with plants and animals. Management and improvement of waste land/barren land. Oil spills, damage and management petroleum and oil shore management.	**15 Hrs**

Suggested Books:

1. Advances in applied microbiology. Vol.X, edited by Wayne W. Umbreit and D. Pearlman Academic Press.

2. Brock biology of Microorganisms. XI edition. By Michael T. Madigan, John M. Martinko. Pearson Education International.

3. Extreme environment. Metabolism of microbial Adaptation. Milton R., Heinirich Academic Press.

4. Extremophiles by Johri B.N. 2000. Springer Werlag, New York.

5. Microbial diversity by Colwd D., 1999, Academic Press.

6. Microbial ecology. Fundamental and applications by Ronald M. Atlas and Richard Bartha. II and IV edition.

7. Microbial Ecology. Ii edition by R. Campbell. Blackwell scientific publication. 8. Microbial life in extreme Environment. Edited by D.J. Kushner. Academic Press.

9. Microbiology : Dynamics and Diversity by Perry.

10. Microbiology of Extreme Environment . Edited by Clive Edward. Open University Press. Milton Keynes.

11. Microbiology of extreme Environment and its potentials for Biotechnology. Edited by N. S. Da Coasta, J. C. Duarata,, R.A.D. Williams. Elsisver applied science, London

12. Thermophiles. General, Molecular and applied Microbiology. Thomas D.Brock. Wiley Interscience publication.

13. Microbial Ecology: Fundamentals and Applications. 4th ed. (Addison-Wesley) Atlas, R.M., and R. Bartha. 1998.

M. Sc. Semester-III
Discipline Specific Core Course (DSC-6) -MICROBIOLOGY- Paper 9
(MMI3T09) (MOLECULAR BIOLOGY AND GENETICS)

Course Outcomes: At the end of the course the students will be able to

1. Demonstrate knowledge of the central dogma of biology
2. Understand the DNA proof reading and repair system of DNA.
3. Know about DNA regulation and post translation modification to became functional proteins
4. Basic understanding of genetics and hereditary

DSC-6 THEORY	Hours: 04 Hours /Week	Marks: 80+20=100	Credit: 04
Unit-I			
Genome organization and Gene Regulation	Structural organization of genome (prokaryotes and eukaryotes), Cot curve analysis, C-value paradox. Regulation of gene expression : An overview on levels of regulation, terminology and operon concepts, enzyme induction and repression; positive and negative regulation in E. coli- lac and ara operons; regulation by attenuation – his and trp operons; antitermination – N protein and nut sites in Lambda phage. Organization and regulation of nif and nod gene expression in bacteria; gal operon in yeast. Global regulatory responses-heat shock response, stringent response and regulation by small molecules such as cAMP and PPGP		**15 Hrs**
Unit-II			
DNA Replication and DNA Repair	General principles, Characteristics of replication, various modes of replication. relation between cell cycle and DNA synthesis, enzymology of DNA replication in prokaryotes and eukaryotes, Mechanism of DNA replication in prokaryotes and eukaryotes, inhibitors of DNA replication. Types of DNA damage-deamination, oxidative damage, alkylation and pyrimidine dimers; repair pathways – mismatch, short patch repair, nucleotide/base, excision repair, recombination repair and SOS repair system.		**15 Hrs**

Unit III		
Protein Biosynthesis and DNA binding proteins	Central dogma theory and flow of genetic information, genetic code and its elucidation, structure and composition of prokaryotic and eukaryotic ribosomes, structural features of rRNA, mRNA and tRNA in relation to function, steps of protein biosynthesis (activation of amino acids, initiation, elongation, termination) in prokaryotes and eukaryotes; post translational modification of proteins and their sorting and targeting; regulation of translation; inhibitors of protein biosynthesis DNA binding proteins: Enhancer sequences and control of transcription. Identification of protein – binding sites on DNA, control of transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination attenuation and anti termination	**15 Hrs**
Unit IV		
Genetics	Mendelian principles (Dominance, segregation, independent assortment, allele, multiple allele), Pseudoallele, codominance, incomplete dominance, pleiotrophy, genome imprinting, penetrance and expressivity, linkage and crossing over, sex linkage, Sex-limited and sex-influenced characters, linkage maps, gene mapping with molecular markers and by using somatic cell hybrid. Deviation from Mendelism: Complex patterns of inheritance, quantitative traits and inbreeding Non-Mendlian inheritance: Cytoplasmic inheritance and imprinting	**15 Hrs**

Suggested Books:

1. Molecular Genetics of Bacteria, 3rd ed. 1998. J.W. Dale. Wiley Publ.
2. Bacterial and Bacteriophage Genetics. 4th ed. 2000. By E.A. Birge. Springer.
3. Modern Genetic Analysis by Griffith.
4. Genetics by Gardner.
5. Molecular Cell Biology. 1995, 3rd ed. by Lodish et al. Scientific American books, W.H. Freeman and Company.

6. Molecular Biology. 1995, by David Freifelder, Narosa Publ. House. 9. Text Book of Molecular Biology. 1994, by Sivarama Sastry et al, Macmillan India Ltd.
7. Genes VIII. 1997. by B. Lewin. Oxford University Press. The Biochemistry of nucleic acids. 1992, 11th ed. by Adams et al, Chapman and Hall.
8. Biochemistry. 1995 by L. Stryer. W.H. Freeman and Co.Biochemistry, 1998, 4th ed. by G.L. Zubay. W.C.B. Publ.
9. Microbial Genetics. 1995, by David Freifelder. Narosa Publ. House.
10. Biochemistry and Molecular Biology. 1997, by W.H. Elliott & D.C. Elliott. Oxford University Press.
11. . Molecular biology of the Gene. 1998, 5th ed. Watson et al, Addison Wesley Longman.
12. Concepts of Genetics, Klug WS and Cummings MR – Prentice Hall

M. Sc. Semester-III

Discipline Specific Core Course (DSC-7) -MICROBIOLOGY- Paper 10 (MMI3T10) (RECOMBINANT DNA TECHNOLOGY AND NANOBIOTECHNOLOGY)

Course Outcomes: At the end of the course the students will be able to

1. Understand the application of recombinant DNA technology in biotechnological research.
2. Achieve a sound knowledge on methodological repertoire which allows them to innovatively apply these techniques in basic and applied fields of life science researches
3. Understand the Synthesis, characterization and application of nanomaterials in biological sciences

DSC-7 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Molecular Cloning Methods	**DNA cloning**: Enzymes used in recombinant DNA technology, High capacity cloning vectors (cosmid, YAC, BAC & PAC), genomic library, cDNA library and chromosome libraries, Transformation, Gene knockout techniques in bacterial and eukaryotic organisms. Screening and identification of genes, Expression vectors, heterologous probes, oligonucleotide probes, microarrays. RNA Analysis and Gene Expression- Methods for RNA isolation and purification. Analysis of gene expression. **PCR**:Steps, advantages,limitations,application,RT-PCR,		**15 Hrs**
	Unit-II		
Other molecular tools for study in Genes	Restriction mapping: DNA sequencing dideoxy and pyrosequencing, DNA fingerprinting. S1 Mapping, primer expressions, DNase footprinting, DMS footprinting. Nuclear run on transcription, reporter gene transcription. **Genome Editing** - Introduction to genome editing techniques-Principles and applications of genome editing techniques. CRISPR-Cas9, site-directed mutagenesis, and other genome editing methods.		**15 Hrs**
	Unit III		
Application of rDNA technology	Overview of the diverse applications of rDNA technology, Gene therapy and its potential in treating genetic disorders, Strategies for gene delivery in therapeutic applications, Production of biopharmaceutical (Somatostatin and anticancer drugs) using recombinant DNA technology, Industrial applications of genetic engineering, such as enzyme production (Proteases and lysozyme), biofuel production, and bioremediation. Introduction to synthetic biology and its integration with genetic engineering.		**15 Hrs**

Unit IV		
Nano-Biotechnology	Concept of Nano-Biotechnology, Properties of nanomaterials, Classification of nanomaterials. Synthesis of nanoparticles: Silver and Silver oxide nanoparticles, Zinc and Zinc oxide nanoparticles. Techniques for detection of nanoparticles: UV-Visible and Infra-red Spectroscopy, and XRD Applications of Nano-Biotechnology: Agriculture and food processing, Biosensors, Drug and gene delivery sysyem, Cancer diagnostic and treatment. Limitations of Nanoparticles	**15 Hrs**

Suggested Books:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB, and Twyman, R, Wiley Blackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (2019) 7th ed., Brown, TA, Wiley Blackwell, ISBN: 978-1119072560.
3. Benjamin Lewis, Genes VIII (3rd Ed.) Oxford University & Cell Press, NY.2004 .
4. Genome 4 (2017) 4th ed., Brown, TA, Garland Science, ISBN: 978-0815345084.
5. Brown T.A . Genomes, 2nd ed, 2002 , Taylor and Francis publishers, New York 5) Primrose S.B, Twyman R.m., and Old R.w.,
6. Principles of gene manipulations, 6th ed, 2002, Blackwell publishers, Oxford.
7. Walker M.J., and Raply R. Molecular biology and biotechnology 4th ed, 2000, Panima publishers, New delhi.,
8. Challa S. S. R. Kumar, Josef Hormes, Carola Leuschner , "Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact", Wiley – VCH.
9. D.S. Goodsell, "Bionanotechnology: Lessons from Nature", Wiley Press.
10. Genomic Medicine: Principles and Practice (2014) 2nd ed., Ginsburg, GS, and Willard, HF, Oxford University Press, ISBN: 978-0199334468.
11. Molecular Genetics and Genomics (2020) 1st ed., Krebs, JE, and Goldstein, ES, Jones & Bartlett Learning, ISBN: 978-1284154544

M. Sc. Semester-III
Discipline Specific Elective Course (DSE-3)-MICROBIOLOGY- Paper 11
(MMI3T11) (DRUG AND DISEASE MANAGEMENT)

Course Outcomes: At the end of the course the students will be able to

1. Acquire knowledge of the terms prodrug, drug, and drug latentiation.
2. Learn about a variety of anti-infective drugs' mechanisms of action, including those of iodophores (providone-iodine), benzylkonium chloride, and genita violet.
3. Understanding the variety of antifungal, antitubercular, antiprotozoal, antimalarial, and antihistaminic medicines' mechanisms of action

DSE-3 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Drug latentiation and Prodrug	History, Prodrug design-Basic concept, Prodrugs to improve patient acceptability, carrier-linked prodrugs, (carrier linkages for various functional groups , carrier-linked bipartite prodrugs, macromolecular drug carrier systems) bioprecursors prodrugs (hydrolytic activation, elimination activation, oxidative activation, reductive activation, nucleotide activation, phosphorylation activation, sulfation activation and decarboxylation ac tivation). , carboxylic acids and alcohols, amines, carboxyl compounds. **Drug-microbe:** Host-parasite relationship, mechanism of drug action and drug resistance including MDR.		**15 Hrs**
	Unit-II		
Antimicrobial agents (chemistry & mode of action)	Anti infective agents:Iodophores (povidone-Iodine), Benzalkonium chloride, gentian violet, mercury compounds. **Antifungal agents:**Ketoconazole, Nystatin, Griseofulvin. Amphotericin B, Clotrimazole, Econazole, Fluoronazole, Miconazole,Tolnaftate, **Antitubercular agents:** Isoniazid, cycloserine Aminosalicylate sodium, Capreomycin, Ethambutol, Rifampicin.		**15 Hrs**

Unit III		
Anti-inflammatory agents (chemistry & mode of action)	**Histamines and Antihistaminic agents**: Cimetidine, Ranitidine, Omeprazole. **H_1 First-Generation:** Meclizine, Clemastine, Hydroxyzine, Brompheniramine, Dimetindene, Doxylamine **H_1 Second-Generation:**Loratadine, Cetirizine, levocetirizine, **H_2:** Ranitidine, Cimetidine, Famotidine, **Analgesic agents:** Paracetamol (acetaminophen) ibuprofen- or diclofenac- *Opioid* Morphine, and their derivatives **Anti-inflammatory analgesics**-Phenylbutazone and oxyphenbutazone, Prostagacetylated salicylates (aspirin), non-acetylated salicylates (diflunisal, salsalate), propionic acids (naproxen, ibuprofen, acetic acids (diclofenac, indomethacin), enolic acids (meloxicam, piroxicam) anthranilic acids	**15 Hrs**
Unit IV		
Anti Parasitic agents (chemistry & mode of action)	**Antiprotozoal agents:** 8-Hydroxyquinoline ,Hydroxychloroquine, Metronidazole Nifursemizone, Ornidazole Antimalarials: Quininesulphate, Atovaquone/Proguanil (Malarone) Chloroquine. Doxycycline.Mefloquine. Primaquine. Pyrimethamine.	**15 Hrs**

Suggested Books:

1. The Organic Chemistry of Drug Design and Drug Action, Silverman R. B., Academic Press.
2. Textbook of Drug Design and Discovery, Eds. Krogsgaard-Larsen P., Liljefors T., Madsen U., Taylor & Francis.
3. Drug Discovery – A History, Sneader W., Wiley.
4. Medicinal Chemistry: An Introduction, Thomas G, Wiley.
5. Drug Discovery – A History, Sneader W, John Wiley & Sons, Ltd.
6. Comprehensive Medicinal Chemistry, Series Ed., Hansch C., Pergamon Press.
7. Wilson and Gisvold's, Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott-Raven
8. Foye's Principles of Medicinal Chemistry, Lippincott Williams and Wilkins.
9. Drug Metabolizing Enzymes-Cytochrome P450 and Other Drug Metabolizing Enzymes in Drug Discovery and Development, Lee JS, Obach SR and Fisher MB, Marcel Dekker, Fontis India, 2003
10. Pharmaceutical Profiling in Drug Discovery for Lead Selection, Borchardt RT, Kerns EH, Lipinski CA, Thakker DR and
Wang B, AAPS Press, 2004
11. Drug Metabolism – Current Concepts, Ionescu C and Caira MR, Springer International Edition
12. Handbook of Drug Metabolism, Woolf TF, Marcel Dekker, 1999
13. Abby L .Parrill.M .Rami Reddy.Rational Drug Design.Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.
14. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey.

M. Sc. Semester-III
Discipline Specific Elective Course (DSE-3)-MICROBIOLOGY- Paper 11
(MMI3T11) (BIOINFORMATICS)

Course Outcomes:

1. The program aims to utilize and understand biological databases to gather, store, retrieve, manage, analyze and integrate biological data for generating new knowledge
2. Better understanding of dynamic biological processes and their understanding at molecular level enabled through and correlated using internet and Bioinformatics.
3. To introduce new age concepts of big data in the 'omics' era and their analysis

DSE-3 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Basic Concepts and Computer Coding	Basic Concept of Computer Organization, Internet, File Transfer Protocol, Browser, Home Page, Hyper text transfer protocol, Uniform Resource Locator, Hyperlink and Web Applications. Computer Coding:- Number system, decimal number system, binary number system, binary to decimal conversion, Binary arithmetic, octal number system, hexadecimal number system.		**15 Hrs**
	Unit-II		
Genomics and Proteomics	Genomics: Nucleotide sequence Databases, its Analysis and Identification Goals of the Human Genome Project, cloning vectors, concept of maps, physical maps, shotgun libraries, DNA polymorphism, nucleotides, DNA sequences. Dot Plots, Simple alignments, Dynamic programming global and local alignments BLAST,FASTA,Scoring matrices,and alignment scores. Multiple sequence alignments. Pattern of substitution within genes, substitution number estimations, molecular clocks. Protein Data bank (PDB), Nucleic Acid Data Bank (NDB),Molecular modeling Data Bank (MMDB)		**15 Hrs**

Unit III		
Phyllogenetics	Phylogenetic analysis:-Evolution, elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life, comparison of genetic sequence of organisms, phylogenetic analysis tools-Phylip, ClustalW. Parsimony,Inferred ancestral sequence, consensus tress,comparison of phyllogenetic methods.	**15 Hrs**
Unit IV		
Protein structure prediction	Protein Structure Prediction:- Homology modeling, prediction of protein structure from sequences, functional sites. protein identification and characterization:- AACompIdent, TagIdent, PepIdent and MultiIdent, PROSEARCH, PepSea, PepMAPPER, FindPept, Predicting transmembrane helices, Primary structure analysis and prediction, Secondary structure analysis and prediction, motifs, profiles, patterns and fingerprints search. Methods of sequence based protein prediction.	**15 Hrs**

Suggested Books:

1. DNA Sequencing: From Experimental Methods to Bioinformatics *Author(s): Luke Alphey*
2. Bioinformatics: The Machine Learning Approach *Author(s): P.Baldi and S. Brunak*
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition *Author(s): Andreas D. Baxevanis and B. F. Francis Ouellette (Eds)*
4. Bioinformatics for Dummies *Author(s): Jean-Michel Claverie and Cedric Notredame*
5. Protein Bioinformatics: An Algorithmic Approach to Sequence and Structure Analysis *Author(s): Ingvar Eidhammer, Inge Jonassen, William R.T. Taylor*
6. Bioinformatics: Genomics and Proteomics Vikas Publishing House (7 November 2014) Author Ruchi Singh

M. Sc. Semester-III
MICROBIOLOGY – PRACTICAL-5 (MMI3P05)

Course Outcomes:

1. Be able perform various diagnostic technique in immunology.
2. Be able to gain knowledge of different bacterial diseases and their diagnosis

LAB-5	Hours: 04 Hours /Week	Marks: 50+50=100	Credit: 02
	Perform minimum 10 from following practical's		
	1) Antibiotic Sensitivity Test by Kirby-Bauer Disk Diffusion method and Isolation of antibiotic resistant microbes. 2)Determination of purity and quantitification of DNA by UV absorption method 3)Determination of melting temperature (Tm) of DNA . 4)Quantification of RNA by orcinol method 5) Isolation of genomic DNA. 6)Analysis of G+C percentage in bacterial DNA 7)DNA fingerprinting by RAPD. 8)Restriction analysis of genomic DNA. 9)Southern blotting analysis of DNA. 10) Isolation of plasmid DNA and determination of molecular size of plasmid DNA. 11) Amplification of gene by PCR. 12) Isolation of RNA by agarose gel electrophoresis. 13)Ligation of DNA into plasmid vectors. 14)Preparation of competent cells. 15)Transformation of E. coli with standard plasmids. 16) Selection of recombinant clones by blue – White screening. 17) Synthesis of silver nanoparticles 18) Synthesis of ZnO nanoparticles through non-aqueous route. 19) To study antibacterial/antifungal activity of nanomaterial.		**30 Hrs**

Suggested Books:

1. Microbiology Laboratory Manual, 5th Edition, James G. Cappucciino and Natalie Sherman
2. Molecular Cloning A Laboratory Manual 1 3rd Edition, J. Sambrook, E.F Fristsch and T. Maniatis
3. Molecular Cloning A Laboratory Manual 2 2nd Edition, J. Sambrook, E.F Fristsch and T. Maniatis
4. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhardt, ASM Publications.

M. Sc. Semester-IV
Discipline Specific Core Course (DSC-8)-MICROBIOLOGY –Paper 12
(MMI4T12) (VIROLOGY)

Course Outcomes: At the end of the course the students will be able to

1. Understand the role of different Viruses in the fields of Microbial science..
2. Understand have about Classification, Composition and the Nomenclature and at the end emerging fields of science with respect to Virology.
3. Develop practical skills to perform different test in identifying important Viruses

DSC-8 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Concept of Virology	History, Classification and composition of viruses Brief outline on discovery of viruses (Origin and evolution), Terminology, Differentiation with other groups of microorganisms. Nomenclature and classification of viruses (Regenmortel et.al.2005, 8th Report of ICTV). Genetic classification Morphology and structure of viruses (size and shape/ symmetry). Chemical composition of viruses (viral capsid, spikes, envelopes and types of viral nucleic acids). Assay of Viruses. Viroids and Prions (Definition, structure, properties and diseases) Interferon: Types and mechanism of action		**15 Hrs**
	Unit-II		
Bacterial viruses	Bacterial viruses Bacteriophages- Structural organization; life cycle (Extracellular phase; attachment, penetration of nucleic acid, transcription, translation, replication, maturation and release of phage particles) of ΦX174, T4, lambda, M13 and Mu Phages. Bacteriophage typing, One step growth curve.		**15 Hrs**
	Unit III		
Animal & Plant Viruses	Animal and Plant viruses**Life cycle, pathogenesis and laboratory diagnosis of following viruses.Animal Viruses**:-**RNA viruses:**Picorna, Orthomyxo, Rhabdovirus and HIV. **DNA viruses**: Pox, Herpes, Adeno and Hepatitis viruses. Oncogenic viruses: Papova viruses, EB virus, HTLV viruses. **Plant virus**: TMV, Cauliflower mosaic virus, potato virus.		**15 Hrs**

Unit IV		
Diagnostic virology	General methods of Diagnosis and antiviral drugs **Serological methods:** -Haemadsorption; Haemadsorption inhibition; haemagglutination; Haemagglutination inhibition(HAI); Complement fixation immunofluorescence methods. ELISA and Radioimmunoassays (RIA). **Antiviral agents:** Structure and Mechanism of action of: Amantadine, Rimantidine, Vidarabine, Acyclovir, Ganciclovir, Ribavirin, Foscarnet, Stavudine, Lamivudine. **NNRTIS** (non-nucleoside RT inhibitors) - Nevirapine; Delavirdine and Efavirenz. Protease inhibitors- Saquinavir, Indinavir and Ritonavir	**15 Hrs**

Suggested Books :

1. Virology :Principles and Application. John Carter and Venesia Saunders.
2. Introduction to Modern Virology, 7th Edition Nigel J. Dimmock, Andrew J. Easton, Keith N. Leppard.
3. Prescott, Hurley. Klein-Microbiology, 7th edition, International edition, McGraw Hill.
4. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002,| McGraw Hill.
5. Michael T. Madigan & J. M. Martin, Brock, Biology of Microorganisms 12th Ed.International edition 2006, Pearson Prentice Hall.
6. Plant Viruses, Diseases and Their Management .by Kajal Kumar Biswas

M. Sc. Semester-IV
Discipline Specific Core Course (DSC-9)-MICROBIOLOGY –Paper-13
(MMI4T13) (MICROBIAL FERMENTATION & TECHNIQUES)

Course Outcomes: At the end of the course the students will be able to

1. Design of bioreactor and its tools, fermentation kinetics.
2. Recovery, purification, packaging and storage of microbial products.
3. Production of different microbial products.

Laboratory management and operations, data preparation and regularly adopted practices in industries.

DSC- 9 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
Unit-I			
General Principles of Fermentation	General Principles of Fermentation, Bioreactors: Typical Bioreactor and designing of their tools, Fermentation kinetics and Monods Model:-Growth kinetics and Monod's Model, Substrate accelerated death, specific growth rate, stringent response (bacterial stress response), Ntr and Pho system, growth limiting substrate, maintenance energy, growth yield and product formation. Process optimization: factors of optimization, rheology of fermentation fluid, oxygenation, and oxygen transfer kinetics. chemostat, turbidostat.		**15 Hrs**
Unit-II			
Downstream Processing	Downstream Processing and scale up. Downstream processes: types of processing units and systems, Storage and packaging methods. Scale up; scale down: criteria involved therein. Productivity, power requirements, Basic control theory.		**15 Hrs**
Unit III			
Industrial Fermentation	Industrial Fermentation of Products - Biofuels (Conventional):- Hydrogen, Methane, Antibiotics:- Streptomycin, Cephalosporin. Probiotic: *Lactobacillus sakei*. Biopolymers:- Xanthan, Polyhydroxyalkanoates. Thermostable enzymes:-Proteases. Biosurfectants. Carotenoides Aminoacids:- Glutamic acid. Vitamins:-riboflavin. Fatty acids (Palmetate, oleate).		**15 Hrs**

Unit IV		
Pharmaceutical industry	Pharmaceutical industry: Laboratory management and design, Bio burden determination, Specified and objectionable microorganisms, Guidelines for preparing a laboratory information file, Assessment of pharmaceutical water systems and Endotoxin and pyrogen testing, Sterilization and sterility assurance, Cleaning and disinfection of production area, Clean rooms and environmental monitoring.	**15 Hrs**

Suggested Books:

1. Pelczar MJ Jr., Chan ECS and Kreig NR., "Microbiology", 5th Edition, Tata McGraw Hill, 1993.
2. Fermentation technology. (1994). Cassida
3. Bioprocess engineering: Down stream processing & recovery of bioproducts, safety in biotechnology and regulations. (1990). Behrens, D. & Kramer, P.(Ed).
4. Enzymes- a practical introduction to structure mechanism and data analysis (2000). Copeland, R.A. 8. Enzymes: Biochemistry, Biotechnology & clinical chemistry (2004). Palmer, T.
5. Encyclopedia of bioprocess technology. Vol 1-5. (1999). Flickinger, M.C. & Drew, S.W.(Ed).
6. Schuler &Kargi, Bio-process Engg. PHI
7. Bailey &Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
8. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001
9. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill
10. Bioseparations: Principles & Techniques (2005). Sivasankar B.

M. Sc. Semester-IV
Discipline Specific Core Course (DSC-10)-MICROBIOLOGY –Paper-14
(MMI4T14) (MEDICAL MICROBIOLOGY AND PARASITOLOGY)

Course Outcomes: At the end of the course the students will be able to

1. Understand types and stages of infection, process of infection. Mechanism of microbial infection
2. learn about pathogenic bacteria, pathogenic fungi, Parasites &Helminths
3. Also learn about New emerging infections, community associated infection and Multidrug resistant microorganisms

DSC-10 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**

	Unit-I	
Infection	**Infection:** Definition, Types, stages of infection, process of infection. **Establishment of pathogenic microorganisms**: Entry, spread and tissue damage. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts, Aggresssins and toxins.	**15 Hrs**
	Unit-II	
Bacteriology	**Pathogenic Bacteria:** Morphological characteristic, Pathogenesis and Laboratory diagnosis including rapid methods of following pathogenic bacteria; *Klebsiella pneumoniae; Proteus vulgaris; Clostridium perfringes; Shigella dysenteriae, Pseudomonas aeruginosa: Vibrio cholerae;, Corynebacterium diphtheriae*	**15 Hrs**
	Unit III	
Mycology and Parasitology	**Pathogenic Fungi:** Morphological characteristics, pathogenesis and laboratory diagnosis of following pathogenic fungi:- *Microsporum; Trichophyton; Histoplasma capsulatum; Blastomyces dermatitidis; Candida albicans; Cryptococcus neoformans; Pneumocystis carinii.* **Parasites:** *Entamoeba histolytica; Giardia Lamblia; Leishmania donovani.* **Helminths***:Taenia saginata; Taeniasolium; Hymenolepis nana; Schitosoma haematobium*	**15 Hrs**
	Unit IV	
New emerging Infections	**New emerging infections:** -*Streptococcus suis; community associated Methicilin resistant Staphylococcus aureus*(MRSA), *Bordetella pertussis,* H1N1, *Multi-drugresistant tuberculosis. Candida auris, Vancomycin resistant enterococci*	**15 Hrs**

Suggested Books:

1. Medical Microbiology.By:G.F.Brooks,J.S.Butel,S.A.morse.
2. Text book of Microbiology.By:Ananthanarayan and Panikar.
3. Medical Microbiology.By:B.S.Nagoba and A.Pichare.
4. Clinical Microbiology and Infection control.By;Elaine Larson.
5. Bacterial Pathogenesis;Molecular and cellular mechanism.By;CamilaLocht and Michel Simonet.
6. Brock Biology of Microorganisms.By: Madigan M.T John M. Martinko and Parker J
7. Viruses and Interferon; current research. By:Karen Mossam
8. Lentiviruses and Macrophages:Molecular and Cellular intereactions. By:Moira Desporf.
9. Molecular Biology of the gene. By: J.D.Watson, N.h.Hoppkins, J.W.Roberts, J.A.Steitz & A.M.Weiner.
10. Essentials of Medical Microbiology: Apurba Sankar Sastry, Bhat Sandhya K.
11. Milestones in Microbiology: by Brock TD

M. Sc. Semester-IV
Discipline Specific Elective Course (DSE-4)-MICROBIOLOGY- Paper-15 (MMI4T15) (VACCINOLOGY)

Course Outcomes: At the end of the course the students will be able to

1. Know the basic concepts of immunity and infection prevention.
2. Know the various vaccination kinds and how they work.
3. Promote analytical and critical decision-making skills by asking questions and working through vaccination-related problems.
4. Establish a broad awareness of the advantages and disadvantages of vaccinations and the skills necessary to evaluate one's own and one's family members' risks

DSE-4 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
Basic concepts of vaccination	A:Introduction to vaccines: a) Historical background of vaccination b) Infections and mechanisms of disease induction c) Basic concepts of immunity (Active and passive immunization;) and protection against infection B. Types of Vaccine- Live, killed, recombinant DNA , DNA vaccines: merits and demerits and protein-based vaccines; Peptide vaccines, conjugate vaccines, RNA Vaccines merits and demerits, Hybrid vaccine; role and properties of adjuvants, antibody engineering- chimeric and hybrid monoclonal antibodies. Vaccine against cancer T cell based vaccine, edible vaccine merits and demerits and therapeutic vaccine; Success stories in vaccinology e.g. Hepatitis, Polio, Small pox, DPT		**15 Hrs**
	Unit-II		
Implementation of vaccination	A:Global vaccination programmes a) Extended Program of Immunization (EPI) for children b) Disease-eradication programs using vaccines c) Mother and child protection via vaccines Pandemic and seasonal influenza vaccination d) Mass immunization programmes B: Vaccination policy and implementation C: New approaches for vaccine delivery; Engineering virus vectors for vaccination; Vaccines for specific targets; Tuberculosis Vaccine; Malaria Vaccine; HIV vaccine.		**15 Hrs**

Unit III		
Vaccine development and application	**Vaccine development and application** A: Making a vaccine and its approval for use in human Biological basis of vaccine development, Novel strategies, Vaccine safety, Vaccine policy issues. a) Targets for vaccine development b) Assessment of new vaccines Approval processes for new vaccine B: Unmet vaccination needs in the public health a) Novel and new infection b) Vaccines for Cancer c) Animal vaccine needs for human health protection. d) Advances in Vaccine development and challenges faced for: HIV, Measles and Tuberculosis and Benefits of vaccination	**15 Hrs**
Unit IV		
Vaccine trials and good clinical practice	Phases of vaccine trials, development of a vaccine protocol, product management, data collection and management, outreach and awareness Overview of national and international regulatory requirements/ guidance for production, Quality control and Current Good Manufacturing Practices (cGMP) implementation. Importance and implementation of cGMP in the production of safe and efficacious biological products/ vaccines, andclean-in-place (CIP) cycle development for process equipment. Equipment cleaning and validation. Validation of sterilization equipment's. Toxicity and potency evaluation of bacterial and viral vaccines: overview of currently approved methods and alternative methods under development.	**15 Hrs**

Suggested Books:

1. *Vaccines,6thEdition*-ByStanleyA.Plotkinet al.Saunders,ISBN: 978-1-4557-0090-5(http://www.sciencedirect.com/science/book/9781455700905)

2. *HealthTopics–Vaccines.World Health Organization .Webaccess: http://www.who.int/topics/vaccines/en/*

3. Vaccines and immunization .US Center for Disease Control and Prevention (CDC) Webaccess: http://www.cdc.gov/vaccines/

4. Immunization against infectious disease (theGreenBook).PublicHealth England.Webaccess: https://www.gov.uk/government/collections/immunisation-against-infectious-disease-the-green-book

5. Recombinant and synthetic vaccines 1994. G.P. 1 Taiwan K.V.S. Rao, V.S. Chauhan, Eds. PP. 528. Springer Scan Publication.

6.New Generation Vaccines. Fourth Edition, Myrone M. Levine , Myron M. Levine, Gordon Dougan , Michael F. Good , Margaret A. Liu , Gary J. Nabel , James P. Nataro, RinoRappuoli.

7.Vaccine Development and Manufacturing. Emily P. Wen (Editor), Ronald Ellis (Editor), Narahari S. Pujar (Editor).

8.Vaccines & Vaccine Technologies. Jose Ronnie Vasconcelos.

9.Indian Pharmacopeia.

M. Sc. Semester-IV
Discipline Specific Elective Course (DSE-4)-MICROBIOLOGY- Paper-15 (MMI4T15) (BIOETHICS, BIOSAFETY AND IPR)

Course Outcomes: At the end of the course the students will be able to

1. Comprehend biosafety regulations and guidelines governing the handling,containment and transport of hazardous materials and apply biosafety principles to ensure environmental and public safety.
2. Understand intellectual property(IP) and differentiate between patents, copyrights, trademark and trade secrets.

DSE-4 THEORY	**Hours: 04 Hours /Week**	**Marks: 80+20=100**	**Credit: 04**
	Unit-I		
History and Basic Concepts	Brief history of bioethics Past and current approaches to bioethics Principles of bioethics – respect of autonomy, non-maleficence, justice, beneficence Medical ethics Public health ethics Ecology and Environmental Ethics		**15 Hrs**
	Unit-II		
Bioethics and Biosafety I	Microbiology and biotechnology research ethics Biomedical Research Ethics Genetic engineering –safety, social, moral and ethical considerations Bioethics, bioweapons and the microbiologist - India's perspective Definition and history of biosafety Principles of biosafety Different levels of biosafety and guidelines		**15 Hrs**
	Unit III		
Bioethics and Biosafety II	Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, Cartagena protocol on biosafety, WTO agreements related to biosafety, Biosafety issues in germplasm Cross border movement Risk management issues - containment. General principles of biosecurity		**15 Hrs**

Unit IV		
IPR	General principles for the laboratory and environmental biosafety Biosafety issues in microbiology and biotechnology laboratories Trade-Related Aspects of Intellectual Property Rights Introduction to copyrights, trademarks, trade secrets, patents, geographical indications in IPR Indian patent act, amendments and patent filing Protection of plant variety and farmers right act Guidelines of IPR on the commercialization of biotechnology products	**15 Hrs**

Suggested Books:

1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
2. Biosafety in Microbiology and biomedical laboratories, 5th Ed. (2009): CDC, NIH publication. HHS publication (21-1112
3. * Rajul K Gupta (2017) Food Safety in the 21st Century: Public Health Perspective. Academic Press.
4. http://dbtbiosafety.nic.in/
5. Alexandra George (2006) Globalisation and Intellectual Property. Ashgate publishing company
6. David Pressman (2016) Patent It Yourself 18th edition, Nolo Publishers

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Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Information Technology)
Choice Based Credit System (Semester Pattern)
wef. 2023-24 as per NEP 2020

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Information Technology)
Choice Based Credit System (Semester Pattern), wef. 2023-24 as per NEP 2020

Pre-requisites to enrol for the M. Sc. (Information Technology) Programme:

The student who has completed the B. Sc. Course with Computer Science as one of the optional subject or Bachelor of Computer Application (BCA)or B. Sc. (IT) or B. Sc. (Data Science) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enroll for M. Sc. (Information Technology)Part I (Semester I). However, the student who has completed four-year B. Sc. course [B. Sc. (Honours)/ (Research) as per NEP- 2020] with Computer Science/Information Technology/Data Science as the major subject or Bachelor of Computer Application (BCA) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol directly to M. Sc. (Information Technology) Part II (Semester III).

Credit distribution structure for two years Post Graduate Programme in Information Technology*

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT/FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6.0	Sem. I	12 (3 theory + 2 Practical)	4	4			20	One Year PG Diploma
		Sem. II	12 (3 theory + 2 Practical)	4		4		20	
Cum. Cr. For PG Diploma/ I year of PG			24	8	4	4	-	40	
Exit option: One Year PG Diploma 40 credits									
II	6.5	Sem. III	12 (3 theory + 2 Practical)	4			4	20	PG Degree After 3 Yr UG or PG degree after 4-Yrs UG
		Sem. IV	12 (3 theory +2 Practical)	4			6	22	
Cum. Cr. For II year of PG			24	8			10	42	
Cum. Cr. For 2 year of PG degree			48	16	4	4	10	82	

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Information Technology)
Choice Based Credit System (Semester Pattern), wef. 2023-24 as per NEP 2020

Semester I

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Artificial Intelligence	MIT1T01	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Cyber Security	MIT1T02	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 1	MIT1T03	4	-	-	4	3	80	20	40	-	-	-	100
4	RM	Research Methodology	MIT1T04	4	-	-	4	3	80	20	40	-	-	-	100
5	DSC	Practical Based on Paper MIT1T01 and MIT1T02	MIT1P01	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MIT1T03 and MIT1T04	MIT1P02	-	-	6	3	-	-	-	-	50	50	50	100
Total				16	-	12	**22**		**320**	**80**		**100**	**100**		**600**

CIE = Continuous Internal Evaluation and SEE = Semester End Examination

Semester II

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Cloud Computing	MIT2T05	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Machine Learning	MIT2T06	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 2	MIT2T07	4	-	-	4	3	80	20	40	-	-	-	100
4	OJT	Apprenticeship/Mini Project (Related to DSC)	MOJ2P01	-	-	8	4	3	-	-	-	50	50	50	100
5	DSC	Practical Based on Paper MIT2T05 and MIT2T06	MIT1P03	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MIT2T07	MIT1P04	-	-	6	3	-	-	-	-	50	50	50	100
Total				12	-	20	**22**		**240**	**60**		**150**	**150**		**600**

Semester III

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Advanced Software Engineering	MIT3T08	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Network Security	MIT3T09	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Internet of Things (IoT)	MIT3T10	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 3	MIT3T11	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP3P01	-	-	8	4	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MIT3T08 ,MIT3T09,MIT3T 10 and MIT3T11	MIT1P05	-	-	4	2	-	-	-	-	50	50	50	100
Total				16	-	12	**22**		**320**	**80**		**100**	**100**		**600**

Semester IV

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
				(Th)	TU	P		Theory				Practical			
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Big Data Analytics	MIT4T12	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Block Chain Technology	MIT4T13	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Deep Learning	MIT4T14	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 4	MIT4T15	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP4P02	-	-	12	6	-	-	-	-	100	100	100	200
Total				16	-	12	22		**320**	**80**		**100**	**100**		**600**

Total Credits for Four Semesters (Two-Year Course): = 88

Total Marks for Four Semesters (Two Year Course): = 2400

Abbreviations:

DSC: Discipline Specific Course, **DSE**: Discipline Specific Elective **SEE:** Semester End Examination, **CIE:** Continuous Internal Evaluation, **OJT:** On the Job Training (Internship/Apprenticeship), **FP:** Field Project, **RM:** Research Methodology, **RP**: Research Project

Elective papers:

In addition to the mandatory papers, the student has to opt for ONE elective paper in each semester from the basket of elective papers mentioned in the following table.

Basket for Elective Courses (4 Credits each)

Semester	Course Category	Name of the course	Course Code
I	Elective 1	a) PHP b) Discrete Mathematics c) Equivalent MOOC course	MIT1T03
II	Elective 2	a) ASP.NET b) Data Mining c) Equivalent MOOC course	MIT2T07
III	Elective 3	a) Neural Network b) Computer Vision c) Equivalent MOOC course	MIT3T11
IV	Elective 4	a) Reinforcement Learning b) Cyber Forensics c) Equivalent MOOC course	MIT4T15

The students can opt either the elective paper taught in the department in offline mode or any other equivalent online course of at least 4 credits offered by MOOC or any other such platform. The student should submit the passing certificate to the College in order to include the marks in the mark sheet. **The MOOCs which is identical to courses offered in this scheme of M.Sc. Information Technology (in terms of contents) and are accessible to the student shall not be allowed for credit transfer.**

M. Sc. (Information Technology)
Semester I

MIT1T01
Paper I: ARTIFICIAL INTELLIGENCE

Hours/Week : 4
Credits : 4

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history.
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
3. To develop intelligent systems by assembling solutions to concrete computational problems

Course Outcomes:

- Evaluate Artificial Intelligence (AI) methods and describe their foundations.
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
- Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
- Analyze and illustrate how search algorithms and planning play vital role in problem solving.

UNIT I

AI problems, AI Techniques, Tic-tac-toe, Question Answering, Problem as a state space search, A water jug problem, production system, Control strategies, Heuristic Search, Problem Characteristics, Production system characteristics, Design of search programs AI Search techniques :- Depth-first, Breadth-first search, Generate-and-test, Hill climbing, Best-first search, Constraint satisfaction, Mean-ends-analysis, A* Algorithm, AO* algorithm.

UNIT II

Knowledge Representation:- Representations and mappings, Knowledge Representations, Issues in Knowledge Representation, Predicate Logic:- Representing Instance and Isa Relationships, Computable Functions and predicates, Resolution, Natural Deduction, Logic programming, Forward versus Backward Reasoning, Matching, Control knowledge, Expert System.

UNIT III

Games playing: Minimax search procedure , adding alpha-beta cutoffs, additional refinements, Planning :- Component of a planning system, Goal task planning, Nonlinear planning, Hierarchical Planning.

UNIT IV

Understanding, Understanding as Constraint satisfaction, Natural Language Processing, Syntactic Processing, Unification grammars, Semantic Analysis, Introduction to pattern recognition, Parallel and Distributed AI, Psychological Modeling, Distributed Reasoning Systems,

Books:

1. Artificial Intelligence by Elaine Rich, Megrawhill Inc.
2. Artificial Intelligence and Expert Systems – Jankiraman, Sarukes (M)
3. Lisp Programming – RajeoSangal – (TMH)
4. Artificial Intelligence – Russell-Pearson- Ist Text book.
5. Principles of AI- Nils Nilson
6. A.I. by R.J.Winston - Pearson

M. Sc. (Information Technology)
Semester I

MIT1T02
Paper II: CYBER SECURITY

Hours/Week : 4
Credits : 4

Course Objectives:

1. To Understand the different types of vulnerability scanning
2. To know the different network defense tools and web application tools
3. To understand the different types of cyber crimes and laws
4. To understand the different tools for cyber crime investigation

Course Outcomes:

- Apply regulation of cyberspace and know the issue and challenges of cyber security.
- Legal perspectives of cyber crime, IT act 2000 and its amendments.
- Social media monitoring : Challenges, opportunities and pitfalls in online social network, Security issues related to social media

UNIT I

Introduction to Cyber security: Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

UNIT II

Cybercrime and Cyber law: Classification of cybercrimes, Common cybercrimes-cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organisations dealing with Cybercrime and Cyber security in India, Case studies.

UNIT III

Social Media Overview and Security: Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

UNIT IV

Digital Devices Security, Tools and Technologies for Cyber Security: End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Books

1. Cyber Crime Impact in the New Millennium, by R. C Mishra ,Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by SumitBelapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13th November, 2001)
4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
7. Fundamentals of Network Security by E. Maiwald, McGraw Hill.

M. Sc. (Information Technology)
Semester I

Elective 1: MIT1T03
Paper III: PHP

Hours/Week : 4
Credits : 4

Course Objectives:

1. To become familiar with client server architecture and able to develop a web application using various technologies.
2. To understand and develop a web-based application using a framework concept.
3. To gain the skills and project-based experience needed for entry into web application and development careers

Course Outcomes:

- Able to Installing and Configuring PHP on Windows and Linux Platforms
- Web page development using PHP

UNIT I

Introduction to PHP: What Does PHP Do, A Brief History of PHP, Installing PHP, A Walk Through PHP Language Basics: Lexical Structure, Data Types, Variables, Expressions and Operators, Flow-Control Statements, Including Code, Embedding PHP in Web Pages, Installing and Configuring PHP on Windows and Linux Platforms

UNIT II

Functions: Calling a Function, Defining a Function, Variable Scope, Function Parameters, Return Values, Variable Functions, Anonymous Functions, Strings: Quoting String Constants, Printing Strings, Accessing Individual Characters, Cleaning Strings, Encoding and Escaping, Comparing Strings, Manipulating and Searching Strings, Regular Expressions, POSIX-Style Regular Expressions, Perl-Compatible Regular Expressions, **Arrays:** Indexed Versus Associative Arrays, Identifying Elements of an Array, Storing Data in Arrays, Multidimensional Arrays, Extracting Multiple Values, Converting Between Arrays and Variables, Traversing Arrays, Sorting, Acting on Entire Arrays, Using Arrays

UNIT III

Classes and Objects: Terminology, Creating an Object, Accessing Properties and Methods, Declaring a Class, Introspection, Serialization, Web Techniques: HTTP Basics, Variables, Server Variables, Server Information, Processing Forms, Setting Response Headers, Session, cookies, files, Maintaining State, SSL, Using PHP to Access a Database: Relational Databases and SQL, Mysql database Basics, Advanced Database Techniques

UNIT IV

Graphics: Embedding an Image in a Page, The GD Extension, Basic Graphics Concepts, Creating and Drawing Images, Images with Text, Dynamically Generated Buttons, Scaling Images, Color Handling, **PDF:** PDF Extensions, Documents and Pages, Text, Images and Graphics, Navigation, Other PDF Features

XML : Lightning Guide to XML, Generating XML, Parsing XML, Transforming XML with XSLT, Web Services, **Security:** Global Variables and Form Data, Filenames, File Uploads, File Permissions, Concealing PHP Libraries, PHP Code, Shell Commands, Security Redux, Application Techniques, Code Libraries, Tinplating Systems, Handling Output, Error Handling, Performance Tuning.

Books:

1. PHP 5.1 for beginners by Evan Bayross and Sharman Shah, SPD publications
2. Programming PHP by Rasmus Lerdorf and Kevin Tatroe, Orilly Publications.

M. Sc. (Information Technology)
Semester I

Elective 1: MIT1T03
Paper III: DISCRETE MATHEMATICS

Hours/Week : 4
Credits : 4

Course Objectives:

1 To cover certain sets, functions, relations and groups concepts for analyzing problems that arise in engineering and physical sciences.
2 To imparting to analyze the problems connected with combinatorics and Boolean algebra.
3 To solve calculus and integral calculus problems.

Course Outcomes:

- Observe the various types of sets, functions and relations.
- Understand the concepts of group theory.
- Understand the concepts of combinatorics.
- Understand the concepts of graph theory and its applications.
- Learning logic and Boolean algebra. Using these concepts to solve the problems

UNIT I

Mathematical Logic: Propositional Calculus: Connectives, statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, duality law, Tautological Implications, functionally complete set of connectives, other connectives. **Normal Forms**: CNF, DNF, PCNF, PDNF.

UNIT II

Fundamentals: Sets and Subsets, operations on sets, sequences, Division of the integer, Matrices, Methods of Proof, Mathematical Induction.
Counting: Permutations, Combinations, The pigeonhole Principle, Recurrence Relations.

UNIT III

Relations and Digraphs: Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations, Operations of Relations, Transitive Closure and Warshall's Algorithms.
Functions: Definition and Introduction, Permutation Functions, Growth of Functions.

UNIT IV

Order Relations and Structures: Partially Ordered Sets, Lattices.
Graph Theory: Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits.
Tree: Introduction, Undirected Tree, Minimal Spanning Trees.
Semigroups and Groups: Binary Operations Revisited, Semigroups, Products and Quotients of Groups.

Books:

1. Discrete Mathematical Structures By Bernard Kolman, Busby & Sharon Ross [PHI].
2. Discrete Mathematical Structures with Application to computer science By J. P. Tremblay & R. Manohar [Tata McGraw –Hill]
3. Discrete Mathematics with Graph Theory by Goodaire[PHI]
4. Discrete Mathematics by J.K.Sharma(McMillan)
5. Discrete Mathematics and its Applications by Kenneth Rosen (TMH)

M. Sc. (Information Technology)
Semester I

MIT1T04
Paper IV: RESEARCH METHODOLOGY

Hours/Week : 4
Credits : 4

Course Objectives:

1. To study and understand the research issues & challenges, research goals, scientific methods
2. To study processing and analysis of data, Quantitative and Qualitative data analysis.
3. Reviewing Literature and research papers, writing research papers, Thesis reports.

Course Outcomes:

- The basic concept of research and its methodologies, Identify appropriate research topics, select and define appropriate research problem and parameters.
- Prepare a project (to undertake a project)
- Organize and conduct research in a more appropriate manner, writing research report and thesis.

UNIT I

Introduction: Meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research processes, criteria of good research, **Defining Research Problem:** necessity of defining the problem, techniques involved in defining a problem, **Research Design**: meaning of research design, need for research design, features of good design, different research designs, basic principles of experimental design.

UNIT II

Methods of Data Collection: Collection of primary data, Observation method, Methods of Data collection, Interview Method, Collection of data through questionnaire, Collection of data through schedules, Difference between questionnaire and schedules, **Processing and Analysis of Data:** Processing operations, Problems in processing, Types of Analysis, Statistics in Research, Simple Regression analysis, multiple correlation and regressions, Partial correlation. **Quantitative Data analysis:** Types of quantitative data, data coding, visual aids for quantitative data analysis using statistics for quantitative data analysis, Interpretation data analysis result, evaluating quantitative data analysis, **Qualitative Data analysis:** Analyzing textual data, analyzing non-textual qualitative data, Grounded theory, computer aided qualitative analysis, evaluating qualitative data analysis.

UNIT III

Interpretation and Report Writing: Techniques of Interpretation, Significance of Report Writing, Different steps in Writing report, Layout of research report, type of report, oral presentation, mechanics of writing a research report **Python Tools:** File Handling, Introduction, Handling Binary data and CSV files, Zipping and Unzipping files, Directory **Regular Expression and Web scraping:** Introduction, Function of Re Module, web scraping.

UNIT IV

LaTeX: Writing scientific report, structure and components of research report, revision and Refining, writing project proposal, paper writing for international journals, submitting to editors conference presentation, preparation of effective slides, pictures, graphs and citation styles.

Books:

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. Briony J. Oastes, Researching Information Systems and Computing, SAG Publication India Pvt. Ltd., New Delhi.
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, Python Programming: A Practical Approach, First edition published 2022 by CRC Press.
4. F. Mittelbach and M. Goossens, The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

M. Sc. (Information Technology)
Semester II

MIT2T05
Paper I: CLOUD COMPUTING

Hours/Week : 4
Credits : 4

Course Objectives:
1. To Understand fundamentals of cloud computing
2. To acquire good working knowledge of the essentials of Cloud Micro Services
3. To implement business specific cloud applications

Course Outcomes:
- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- Compare the advantages and disadvantages of various cloud computing platforms.
- Program data intensive parallel applications in the cloud.
- Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
- Identify security and privacy issues in cloud computing.

UNIT I
Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Intercloud, Types of Clouds, Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology, Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

UNIT II
Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Understanding Core OpenStack Ecosystem. Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications (Social Networking, E-mail, Office Services, Google Apps, Customer Relationship Management).

UNIT III
Basic Terms and Concepts, Threat Agents, Cloud Security Threats and Attacks, Additional Considerations. Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Hardened Virtual Server Images. Cloud Issues: Stability, Partner Quality, Longevity, Business Continuity, Service-Level Agreements, Agreeing on the Service of Clouds, Solving Problems, Quality of Service, Regulatory Issues and Accountability. Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud.

UNIT IV
Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking. How the Cloud Will Change Operating Systems,

Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing.Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
2. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition.
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
5. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security, and More, Jones and Bartlett, ISBN :9789380853772.
6. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.

M. Sc. (Information Technology)
Semester II

MIT2T06
Paper II: MACHINE LEARNING

Hours/Week : 4
Credits : 4

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes:

- Understand the concepts of various machine learning strategies.
- Handle computational data and learn ANN learning models.
- Solve real world applications by selecting suitable learning model.
- Boost the performance of the model by combining results from different approaches.

UNIT I

Learning: Types of Machine Learning, Supervised Learning, The Brain and the Neuron, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Linear Discriminants, Perceptron, Linear Separability, Linear Regression.

UNIT II

Multi-layer Perceptron: Going Forwards, Going Backwards: Back Propagation Error, Multilayer Perceptron in Practice, Examples of using the MLP, Overview, Deriving BackPropagation, Radial Basis Functions and Splines, Concepts, RBF Network, Curse of Dimensionality, Interpolations and Basis Functions, Support Vector Machines.

UNIT III

Learning with Trees: Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Probability and Learning, Data into Probabilities, Basic Statistics, Gaussian Mixture Models, Nearest Neighbor Methods, Unsupervised Learning, K means Algorithms, Vector Quantization, Self Organizing, Feature Map

UNIT IV

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Isomap, Least Squares Optimization, Evolutionary Learning, Genetic algorithms, Genetic Offspring: Genetic Operators, Using Genetic Algorithms, Reinforcement Learning, Overview, Getting Lost Example, Markov Decision Process. Graphical Models: Markov Chain Monte Carlo Methods, Sampling, Proposal Distribution, Markov Chain Monte Carlo, Graphical Models, Bayesian Networks, Markov Random Fields, Hidden Markov Models, Tracking Method.

Books:

1. Introduction to Machine Learning (Adaptive Computation and Machine Learning Series), EthemAlpaydin,Third Edition, MIT Press
2. Machine learning – Hands on for Developers and Technical Professionals, Jason Bell, Wiley
3. Machine Learning: The Art and Science of Algorithms that Make Sense of Data!, Peter Flach,Cambridge University Press.
4. Deep Learning , Rajiv Chopra, Khanna Publi.
5. Machine Learning, V. K. Jain, Khanna Publi

M. Sc. (Information Technology)
Semester II

Elective 2: MIT2T07
Paper III: ASP.NET

Hours/Week : 4
Credits : 4

Course Objectives:

1. To understand ASP.NET structure
2. To understand Error handling, Component based programming.

Course Outcomes:

- Able to Installing and Configuring .NET framework
- Web development using ASP.NET

UNIT I

Introduction to ASP .NET – The .NET Framework, The .NET Programming Framework, .NET Languages, The .NET Class Library, About ASP .NET, Basic difference between C# and VB .NET, Data Types, Declaring Variables – Initializers, Arrays, Enumerations. Variable Operations –Advanced Math Operations, Type Conversions. Delegates.

UNIT II

The Basics about Classes - Shared Members, A Simple Class, Adding properties, Basic Method, Basic Event, Constructors. Value Types & Reference Types – Assignment Operations, Equality Testing. Advanced Class Programming – Inheritance, Shared Members, Casting. Understanding Namespaces and Assemblies – Importing Namespaces, Assemblies.

UNIT III

Web Server and user - Installing US. US Manager - Creating a virtual Director, Virtual Directories and Applications, Folder Settings, Adding virtual directory to your Neighborhood.Installing ASP.NET. ASP.NET Applications - ASP .NET file Types. The bin directory. Code- Behind. The Global .asax Code-Behind. Understanding ASP. Net Classes. ASP .NET Configuration.**Web Controls** - Basic Web Control classes. Auto PostBack and Web Control Events. A Web page Applets. Validation and Rich Controls.

UNIT IV

State Management Tracing, Logging and Error Handling - Common errors, .NET Exception Object. Handling Exceptions, Throwing your own Exceptions, Logging Exceptions, Error pages, Page tracing. **Advanced ASP.NET -Component-Based Programming** - Creating Simple Component. Properties and State. Database Components. Using COM Components. Custom Controls-User Controls. Deriving Custom controls.

Books:

1. The Complete Reference - ASP .NET by Matthew MacDonald - Tata McGraw- Hill
2. Introducing MicrosoftDot Net, DavidPlatt,PHIPublication.
3. ASP .NET 4.5(Covers C# and VB codes),Black Book, Dreamtech Publication

M. Sc. (Information Technology)
Semester II

Elective 2: MIT2T07
Paper III: DATA MINING

Hours/Week : 4
Credits : 4

Course Objectives:

1. To introduce the fundamental processes data warehousing and major issues in data mining.
2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
3. To develop the knowledge for application of data mining and social impacts of data mining.

Course Outcomes:

- Interpret the contribution of data mining to the decision-support systems.
- Prepare the data needed for data mining using preprocessing techniques and apply the various visualization techniques.
- Discover interesting patterns from large amounts of data using Association Rule Mining
- Extract useful information from the labeled data using various classifiers and Predictors

UNIT I

Introduction to Data Mining: What is Data Mining? Motivating Challenges, Definitions, Origins of Data Mining, Data Mining Tasks, Data: Types of Data- Attributes and Measurement and Types of data sets, Data Quality-Measurement and Data Collection Issues, Issues Related to Applications, Data Preprocessing- Aggregation, Sampling, Dimensionality Reduction, Feature subset selection, Feature creation, Discretization and Binarization, Variable Transformation.

UNIT II

Exploring Data: The Iris Data Set, Summary Statistics- Frequencies and Mode, Percentiles, Measures of Location: Mean and Median, Measures of Spread: Range and Variance, Multivariate Summary Statistics, Visualization: Representation, Arrangement, Selection, Visualization Techniques: Histograms, Box Plots, Scatter Plots, Contour Plots, Matrix Plots, Parallel Coordinates, Visualizing Higher-Dimensional data, OLAP and Multidimensional data Analysis, Classification: Basic Concepts, Decision Trees, and Model Evaluation: Preliminaries, General Approach to Solving Classification Problem, Decision Tree Induction, Evaluating the Performance of a Classifier, Methods for Comparing Classifiers.

UNIT III

Classification: Alternative Techniques: Rule-Based Classifier, Rule Ordering Schemes, Building Rules-Based Classifier, Nearest Neighbor Classifiers, Bayesian Classifiers, Naive Bayes Classifier, Artificial Neural Networks (ANN), Support Vector Machines. Association Analysis: Basic Concepts and Algorithms: Problem Definition, Frequent Itemset Generation- Apriori Principle, Candidate Generation and Pruning, Support Counting, Computational Complexity, Rule Generation, Compact Representation of Frequent Itemsets, Alternative Methods for Generating Frequent Itemsets, FP-Growth Algorithm, FP-Tree Representation.

UNIT IV

Cluster Analysis: Basic Concepts and Algorithms: What is Cluster Analysis? Different Types of Clustering, Types of Clusters, Clustering Algorithms: K-means and its variants, Hierarchical clustering, Density based clustering, Graph-Based Clustering, Shared Nearest Neighbor

Approach, Jarvis Patrick Clustering, SNN Density-Based Clustering, Anomaly Detection: Causes of Anomaly Detection, Approaches to Anomaly Detection, Statistical Approaches, Proximity-Based Outlier Detection, Density-based Outlier Detection, Clustering-Based Techniques.

Books:

1. Introduction to Data Mining, Tan, Steinbach, Kumar.
2. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, Morgan Kaufmann
3. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten and Eibe Frank, Morgan Kaufmann
4. Principles of Data Mining: David Hand, HeikkiMannila and Padhraic Smyth, PHP

M. Sc. (Information Technology)
Semester III

MIT3T08
Paper I: ADVANCED SOFTWARE ENGINEERING

Hours/Week : 4
Credits : 4

Course Objective:
The course offers students to develop the ability to design software systems and analyse and test their performance.

Course Outcomes:
On successful completion of this subject students should be able to:

- To demonstrate an understanding of advanced knowledge of the practice of software engineering, design, validation, test and deployment.
- Use modern engineering principles, processes, and technologies to solve difficult engineering issues and tasks.
- Demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.
- Identify the proper ethical, financial, and environmental effects of their work.

Unit I
Introduction to Software Engineering, Software Engineering as a Layered Technology, Software Development Life Cycle, Generic View of process, A process framework, Process Model – Waterfall, Incremental, Evolutionary, Unified Process Model, Agile Process Model, Scrum, Dynamic System development model, CMMI.

Unit II
System Models: Context Model, Behavioural Model, Data Model, Object Model, Modelling with UML, Design Engineering: Design Process, Design Quality, Design Concepts: Abstraction, Architecture, Patterns, Information Hiding, Functional Independence, Modularity, Design Model: OO Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Unit III
Testing Strategies, Strategic Approach to software testing: Verification, Validation, Error, Fault, Bug, Failure. Types of software testing: Unit Testing, White Box Testing, Black Box Testing, Software Quality Assurance: Software Reliability, Risk Management: Reactive, Proactive risk, Risk Identification, Risk Projection, Risk Refinement, RMMM plan.

Unit IV
Software Metrics: Software Sizing, LOC, FP Based estimations, estimation model, COCOMO Model, Project Scheduling, Time Line Chart, Software Configuration Management: Change Control and version control, software Reuse, Software Re-engineering, Reverse Engineering.

Books:
1. Software Engineering: A Practitioner's Approach, Roger Pressman, Macgraw Hill International Edition.
2. Fundamentals of Software Engineering, Carlo Gheezzi, Mehdi Jazayeri, Dino Mandrioli, PHI Publication.

M. Sc. (Information Technology)
Semester III

MIT3T09
Paper II: NETWORK SECURITY

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on Network security, various encryption techniques, and intrusion detection and the solutions to overcome the attacks.

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify the symmetric encryption techniques
- Illustrate various Public key cryptographic techniques
- Evaluate the authentication and hash algorithms.
- Basic concepts of system level security

Unit - I

Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Nonrepudiation, Cryptographic Techniques.

Unit – II

Principles of Cryptography Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard, Key distribution, Attacks, Public key Cryptography RSA, Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures.

Unit - III

PKI and Security Practices Digital Certificates, MD5, SHA, Challenge Response protocols-Authentication applications, Kerberos, X.509, Securing Email, Web Security.

Unit - IV

Software Vulnerabilities Buffer Overflow, Cross Site Scripting, SQL Injection, Case Studies on worms and viruses, Virtual Private Networks, Firewalls **Wireless Security** Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things

Books:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education, 7th edition, 2016.
2. Behrouz A. Forouzan, Cryptography and networksecurityMCGrawHill3rdEdition
3. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books:

1. Applied Cryptography - Schnier
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004.
3. E. Rescorla, "SSL and TLS: Designing and Building Secure Systems", Addison-Wesley, 2001.
4. B.L. Menezes, "Network Security and Cryptography", Wadsworth Publishing Company Incorporated, 2012.
5. Handbook of Applied Cryptography - Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone: Online Version

M. Sc. (Information Technology)
Semester III

MIT3T10
Paper III: INTERNET OF THINGS (IoT)

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on IoT and protocols, it expose the student to some of the electrical application areas where Internet of Things can be applied..

Course Outcomes:

On successful completion of this subject students should be able to:

- Able to understand the application areas of IoT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics.

UNIT I

Introduction to IOT , Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real time Examples of IoT, Overview of IoT components and IoT, Communication Technologies, Challenges in IOT.

UNIT II

Arduino Simulation Environment, Arduino Uno Architecture, Setup the IDE, Writing Arduino Software , Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD

UNIT III

Sensor & Actuators with Arduino , Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino

UNIT IV

Basic Networking with ESP8266 WiFi module, Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server- introduction, installation, configuration

Posting sensor(s) data to web server

Books:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet ofThings", Springer, 2011
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applicationsand Protocols", Wiley, 2012.

Referenced Book:

1.Vijay Madisetti and ArshdeepBahga, "Internet of Things: (A Hands-on Approach)", Universities Press (INDIA) Private Limited 2014, 1st Edition
2. Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", Pearson Education 2015
3. Cuno Pfister, "Getting Started with the Internet of Things", O'Reilly Media 2011

M. Sc. (Information Technology)
Semester III

Elective 3: MIT3T11
Paper IV: NEURAL NETWORK

Hours/Week : 4
Credits : 4

Course Objectives:

1. To introduce the foundations of Artificial Neural Networks
2. To learn various types of Artificial Neural Networks

Course Outcomes:

- Ability to understand the concepts of Neural Networks.
- Ability to select the Learning Networks in modeling real world systems

UNIT I

Introduction: Feedforward Neural Networks: Artificial Neurons, Neural Networks and Architectures: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Network Geometry of Binary Threshold Neurons and Their Network: Patterns Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are pattern Dichotomizes, Non-linearly separable Problems, Capacity of a simple Threshold Logic Neuron, Revisiting the XOR Problem, Multilayer Networks.

UNIT II

Supervised Learning I: Perceptrons and LMS: Learning and Memory, From Synapses to Behaviour: The Case of Aplysia, Learning Algorithms, Error Correction and Gradient Descent Rules, The Learning Objective for TLNs, Pattern space and Weight Space, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable Sets, Handling Linearly Non-Separable sets, α-Least Mean Square Learning, MSE Error Surface and its Geometry, Steepest Descent Search with Exact Gradient Information, μ-LMS: Approximate Gradient Descent, Application of LMS to Noise Cancellation

UNIT III

Supervised Learning II: Backpropagation and Beyond: Multilayered Network Architectures, Backpropagation Learning Algorithm, Structure Growing Algorithms, Fast Relatives of Backpropagation, Universal Function Approximation and Neural Networks, Applications of Feedforward Neural Networks, Reinforcement Learning

UNIT IV

Neural Networks: A Statistical Pattern Recognition Perspective: Introduction, Bayes Theorem, Classification Decisions With Bayes Theorem, Probabilistic Interpretation Of A Neuron Discriminant Function, Interpreting Neuron Signals As Probabilities, Multilayered Networks, Error Functions And Posterior Probabilities, Error Functions For Classification Problems

Generalization: Support Vector Machines and Radial Basis Function Networks: Learning from Examples and Generalization, Statistical Learning Theory Briefer, Support Vector Machines, Radial Basis Function Networks, Regularization Theory Route to RRBFNs, Generalized Radial Basis Function Network, Learning In RRBFNs, Image Classification Application, Other Models for Valid Generalization.

Books:

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, Tata

Mcgraw Hill
3. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2nd edition 2004
4. Artificial neural networks - B.Yegnanarayana, Prentice Hall of India P Ltd 2005.
5. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
6. Neural networks James A Freeman David M S kapura, Pearson education 2004.

M. Sc. (Information Technology)
Semester III

Elective 3: MIT3T11
Paper IV: COMPUTER VISION

Hours/Week : 4
Credits : 4

Course Objective: The course offers to introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.

Course Outcomes:

On successful completion of this subject students should be able to:

- Implement fundamental image processing techniques required for computer vision.
- Develop computer vision applications.

Unit - I

Recognition Methodology: Conditioning, Labeling, Grouping, Extracting, Matching, Edge detection, Gradient based operators, Morphological operators, Spatial operators for edge detection, Thinning, Region growing, region shrinking, Labeling of connected components.

Unit - II

Binary Machine Vision: Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation.

Unit - III

Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting,Curve fitting (Least-square fitting). **Region Analysis**: Region properties, External points, Spatial moments, Mixed spatial gray-level moments, Boundary analysis: Signature properties, Shape numbers.

Unit - IV

Facet Model Recognition: Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking, Perspective Projective geometry, Inverse perspective Projection, Photogrammetry - from 2D to 3D, Image matching: Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching.

Books:

1. David A. Forsyth, Jean Ponce,"Computer Vision: A Modern Approach"
2. R. Jain, R. Kasturi, and B. G. Schunk, "Machine Vision", McGraw-Hill.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning.
4. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison- Wesley, 1993.

M. Sc. (Information Technology)
Semester IV

MIT4T12
Paper I: BIG DATA ANALYTICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers students to develop understanding towards the basic concepts of Big Data, adaptation and planning of Big Data and Business Intelligence

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify and categorize different types of Data Analytics
- frame Business Architecture
- Understand the use of Information and Communication Technology
- Differentiate Between Traditional data Analysis and Big Data Analytics
- Evaluate different Enterprise Technologies and Big Data Business Intelligence

Unit – I

Concepts and terminology: Data Sets, Data Analysis, Data Analytics - Descriptive, Diagnostic, Predictive, Prescriptive Analytics, Business Intelligence, Big Data Characteristics - Volume, Velocity, Variety, Veracity and Value. Different types of Data - Structured, Unstructured, Semi-Structured, Meta Data Business Motivations and Drivers for Big Data Adoption.

Unit - II

Big Data Analytics Life cycle - Business Case Evaluation, Data Identification, Data Acquisition and Filtering, Data Extraction, Data Validation and Cleansing, Data Aggregation and Representation, Data Analysis, Visualization, Utilization of Analysis Results.

Unit - III

Enterprise Technologies - OLTP, OLAP, ETL Big Data BI, Clusters, Big Data Storage Concepts, Big Data Processing Concepts, Big Data Storage Technology - On Disk Storage Devices, NOSQL Databases, In-Memory Storage Devices.

Unit - IV

Big Data Analysis Techniques - Quantitative, Qualitative, Statistical Analysis, Semantic Analysis, Visual Analysis, Introduction to Hadoop, Map Reduce, Hive, Pig, Spark and Big Data Analytics.

Books:

1. Big Data Fundamentals Concepts, Drivers & Techniques Thomas ErL, Wajid Khattak and Paul Buhler, Pearson Publication 2022.
2. Big Data Analytics Introduction to Hadoop, Spark and Machine- Learning, RajKamal, Preeti Saxena, McGraw Hill Publication, 2019.

M. Sc. (Information Technology)
Semester IV

MIT4T13
Paper II: BLOCK CHAIN TECHNOLOGY

Hours/Week : 4
Credits : 4

Course Objective: To understand the technology behind blockchain, comprehend the issues related to blockchain and study the real-world applications of blockchain

Course Outcomes:
On successful completion of this subject students should be able to:

- Understand the requirements of the basic design of blockchain
- Identify the need of blockchains to find the solution to the real-world problems
- Summarize the working of blockchain
- Recognize the underlying technology of transactions, blocks, proof-of-work,
- and consensus building
- Design and implement new ways of using blockchain for applications other than cryptocurrency
- Categorize and implement the various platforms

Unit I
Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges. What is a Blockchain? Public Ledgers, Blocks in a Blockchain, Blockchain as public ledgers, Transactions, Distributed consensus.

Unit II
Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory, Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory, Design methodology for Blockchain applications, Blockchain application templates, Blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems.

Unit III
Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mist wallet, smart contract examples, smart contract patterns, Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps

Unit IV
Byzantine fault tolerance, proof-of-work vs proof-of-stake, Security and Privacy of Blockchain, smart contract vulnerabilities, Scalability of Blockchain

Books:
1. Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.

Reference Book:

1. Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2. Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3. Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017.
4. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology, William Mougayar, Wiley, 2016.
5. Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.

M. Sc. (Information Technology)
Semester IV

MIT4T14
Paper III: DEEP LEARNING

Hours/Week : 4
Credits : 4

Course Objectives: The course offers to understand major deep learning algorithms and to identify deep learning techniques suitable for a given problem.

Course Outcomes:

On successful completion of the course students will be able to:

- Solve various deep learning problems
- Apply autoencoders for unsupervised learning problems
- Implement Convolutional Neural Networks to image classification problems
- Apply recurrent neural network to sequence Learning Problem.

Unit - I

Introduction to Neural Networks: Feed Forward Neural Networks, Backpropagation , Gradient Descent (GD) Principal Component Analysis: Eigenvalues and eigenvectors, Eigenvalue Decomposition Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition.

Unit – II

Autoencoders: Under complete Auto encoders, Regularization in auto encoders, De-noising auto encoders, Sparse auto encoders, Contractive auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Noise Robustness

Unit - III

Convolutional Neural Networks: The Convolution Operation, Motivation, Pooling, Le Net, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation.

Unit - IV

Recurrent Neural Networks: Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, LSTMs, GRUs, The Challenge of Long-Term Dependencies, Attention Mechanism.

Books:

1. Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
2. Deep Learning from Scratch, Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books:

1. Deep Learning by Ian Good fellow, Yoshua Bengio and Aaron Courville MIT press

M. Sc. (Information Technology)
Semester IV

Elective 4: MIT4T15
Paper IV: REINFORCEMENT LEARNING

Hours/Week : 4
Credits : 4

Course Objectives:

- Learn how to define RL tasks and the core principals behind the RL, including policies, value functions.
- Understand and work with tabular methods to solve classical control problems.
- Recognize current, advanced techniques and applications in RL.

Course Outcome:

- Implement in-code common algorithms following code standards and libraries used in RL.
- Understand and work with approximate solutions.
- Explore imitation learning tasks and solutions.
- Learn how to define RL tasks and the core principals behind the RL, including policies, value functions.
- Understand and work with tabular methods to solve classical control problems.
- Recognize current advanced techniques and applications using RL.

Unit I

Reinforcement Learning Primitives: Introduction and Basics of RL, Defining RL Framework, Probability Basics: Probability Axioms, Random Variables, Probability Mass Function, Probability Density Function, Cumulative Distribution Function and Expectation. Introduction to Agents, Intelligent Agents – Problem Solving – Searching, Logical Agents.

Unit II

Markov Decision Process and Dynamic Programming: Markov Property, Markov Chains, Markov Reward Process (MRP), Bellman Equations for MRP, Dynamic Programming: Polices (Evaluation, Improvement, Iteration, Value Iteration), Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming.

Unit III

Monte Carlo Methods and Temporal Difference Learning: Monte Carlo: Prediction, Estimation of Action Values, Control and Control without Exploring Starts, Off-Policy Control, Temporal Difference Prediction: TD(0), SARSA: On-Policy TD control, Q-Learning: Off-Policy TD control, Games, After states, and Other Special Cases.

Unit IV

Deep Reinforcement Learning: Deep Q-Networks, Double Deep-Q Networks (DQN, DDQN, Dueling DQN, Prioritized Experience Replay). Introduction to Policy-based Methods, Vanilla Policy Gradient, REINFORCE Algorithm and Stochastic Policy Search.

Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.
2. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach.", Pearson Education Limited, 2016.
3.Michael Wooldridge, "An Introduction to Multi Agent Systems", John Wiley, 2002

M. Sc. (Information Technology)
Semester IV

Elective 4: MIT4T15
Paper IV: CYBER FORENSICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers to Identify, gather, and preserve the proof of a law-breaking and to track and prosecute the perpetrators in an exceedingly court of law.

Course Outcomes:

On successful completion of this subject students should be able to:

- To learn investigation tools and techniques, analysis of data to identify evidence.
- To analyze the technical Aspects & Legal Aspects related to cyber crime.

Unit – I

Recent amendments in IT Act, internet & web technologies, web hosting and development, attributes in cyberspace and legal framework of cyberspace, hacking, virus, obscenity, pornography, programme manipulation, Copyright, Patent, software piracy, intellectual property rights, trademark, domain disputes, and computer security, etc., Encryption and Decryption methods, Search and seizures of evidence. Investigation of cyber crimes and tools for analysis.

Unit – II

Information security: Domains, Common Attacks, Impact of Security Breaches. Protecting Critical Systems (Information Risk Management, Risk Analysis etc) Information Security in Depth Physical security (Data security Systems and network security) Program Security: Secure programs, Non-malicious program errors, Viruses and other malicious code, Targeted malicious code, Controls against program threats File protection mechanism. Authentication: Authentication basics, Password, Challenge response, Biometrics. Network Security: Threats in networks, Network security control, Firewalls, Intrusion detection systems, Secure e-mail, Networks and cryptography, Example protocols: PEM, SSL, IPsec. Principles of network forensics, Attack Trace-back and attributes, Critical Needs Analysis. IDS: Network based Intrusion Detection and Prevention Systems, Host based Intrusion Prevention System. Cloud Computing-Its Forensic and Security Aspects.

Unit – III

Cyber Crime Investigations: Where Evidence Resides on Windows systems, Conducting a Windows investigation, File Auditing and Theft of information, Handling the Departing Employee, Steps in a Unix Investigation, Reviewing Pertinent Logs, Performing Keywords Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships, Detecting Trojan Loadable Kernel Models. Finding Network based Evidence, Generating Session data with TCP Trace, Reassembling sessions using TCP flow and Ethereal.

Unit – IV

Open source tools for digital forensics and Registry Forensic- Open source, Open source examination platform, preparing the examination system, using LINUX and Windows as host, Study of Sleuth Kit: Installing Sleuth Kit, Sleuth Kit tools (Volume layer tools, File system Layer tools, Data unit Layer tools, Metadata Layer Tools) Registry Analysis, Understanding Windows Registry and Registry Structure.

Books:

1. C. P. Pfleeger, and S. L. Pfleeger, "Security in Computing", Pearson Education.
2. Computer Forensic Investigating Data and Image Files, EC Council Press
3. Robert Jones, Internet Forensics Using Digital Evidence to Solve Computer Crimes, O'Reilly Media Publication
4. Forouzan Data Communication and Networking McGraw Hill
5. Stallings, "Cryptography And Network Security: Principles and practice"
6. Kevin Mandia, Chris Prosise and Matt Pepe, Incident response and computer forensics, McGraw Hill Publication
7. Cory Altheide, Harlan Carvey, Digital Forensics with Open source Tools, Syngress Publication
8. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003
9. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC Press LLC, 2004.

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Computer Science)
Choice Based Credit System (Semester Pattern)
wef. 2023-24 as per NEP 2020

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Computer Science)
Choice Based Credit System (Semester Pattern), wef. 2023-24 as per NEP 2020

Pre-requisites to enrol for the M. Sc. Computer Science Programme:

The student who has completed the B. Sc. Coursewith Computer Science as one of the optional subject or Bachelor of Computer Application (BCA)or B. Sc. (IT) or B. Sc. (Data Science) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol for M. Sc. (Computer Science)Part I (Semester I). However, the student who has completed four-year B. Sc. course [B. Sc. (Honours)/(Research) as per NEP- 2020] with Computer Science/Information Technology/Data Science as the major subject or Bachelor of Computer Application (BCA) with not less than 45% of aggregate marks (40% in case of student from reserved category) or equivalent CGPA from any of the recognised university is eligible to enrol directly to M. Sc. (Computer Science) Part II (Semester III).

Credit distribution structure for two years Post Graduate Programme in Computer Science*

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT/FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6.0	Sem. I	12 (3 theory + 2 Practical)	4	4			20	OneYear PG Diploma
		Sem. II	12 (3 theory + 2 Practical)	4		4		20	
Cum. Cr. For PG Diploma/ I year of PG			24	8	4	4	-	40	
Exit option: One Year PG Diploma 40 credits									
II	6.5	Sem. III	12 (3 theory +2 Practical)	4			4	20	PG Degree After 3 Yr UG or PG degree after 4-Ys UG
		Sem. IV	12 (3 theory +2 Practical)	4			6	22	
Cum. Cr. For II year of PG			24	8			10	42	
Cum. Cr. For 2 year of PG degree			48	16	4	4	10	82	

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Board of Studies (Computer Science)
Syllabus
of
M. Sc. (Computer Science)
Choice Based Credit System (Semester Pattern), wef. 2023-24 as per NEP 2020

Semester I

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Artificial Intelligence	MCS1T01	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Compiler Construction	MCS1T02	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 1	MCS1T03	4	-	-	4	3	80	20	40	-	-	-	100
4	RM	Research Methodology	MCS1T04	4	-	-	4	3	80	20	40	-	-	-	100
5	DSC	Practical Based on Paper MCS1T01 and MCS1T02	MCS1P01	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS1T03 and MCS1T04	MCS1P02	-	-	6	3	-	-	-	-	50	50	50	100
Total				16	-	12	**22**		**320**	**80**		**100**	**100**		**600**

CIE = Continuous Internal Evaluation and SEE = Semester End Examination

Semester II

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Cloud Computing	MCS2T05	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Machine Learning	MCS2T06	4	-	-	4	3	80	20	40	-	-	-	100
3	DSE	Elective 2	MCS2T07	4	-	-	4	3	80	20	40	-	-	-	100
4	OJT	Apprenticeship/Mini Project (Related to DSC)	MOJ2P01	-	-	8	4	3	-	-	-	50	50	50	100
5	DSC	Practical Based on Paper MCS2T05and MCS2T06	MCS1P03	-	-	6	3	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS2T07	MCS1P04	-	-	6	3	-	-	-	-	50	50	50	100
Total				12	-	20	**22**		**240**	**60**		**150**	**150**		**600**

Semester III

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Advanced Software Engineering	MCS3T08	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Network Security	MCS3T09	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Digital Image Processing	MCS3T10	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 3	MCS3T11	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP3P01	-	-	8	4	-	-	-	-	50	50	50	100
6	DSC	Practical Based on Paper MCS3T08 ,MCS3T09,MCS3 T10 and MCS3T11	MCS1P05	-	-	4	2	-	-	-	-	50	50	50	100
Total				16	-	12	22		320	80		100	100		600

Semester IV

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme							
								Theory				Practical			
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.	Total
1	DSC	Big Data Analytics	MCS4T12	4	-	-	4	3	80	20	40	-	-	-	100
2	DSC	Computer Vision	MCS4T13	4	-	-	4	3	80	20	40	-	-	-	100
3	DSC	Deep Learning	MCS4T14	4	-	-	4	3	80	20	40	-	-	-	100
4	DSE	Elective 4	MCS4T15	4	-	-	4	3	80	20	40	-	-	-	100
5	RP	Research Project/ Dissertation (Core)	MRP4P02	-	-	12	6	-	-	-	-	100	100	100	200
Total				16	-	12	22		320	80		100	100		600

Total Credits for Four Semesters (Two Year Course): = 88

Total Marks for Four Semesters (Two Year Course):= 2400

Abbreviations:

DSC: Discipline Specific Course, **DSE**: Discipline Specific Elective **SEE**: Semester End Examination, **CIE:** Continuous Internal Evaluation, **OJT:** On the Job Training (Internship/Apprenticeship), **FP:** Field Project, **RM:** Research Methodology, **RP**: Research Project

Elective papers:

In addition to the mandatory papers, the student has to opt for ONE elective paper in each semester from the basket of elective papers mentioned in the following table.

Basket for Elective Courses (4 Credits each)

Semester	Course Category	Name of the course	Course Code
I	Elective 1	a) Computer Architecture & Organization b) Discrete Mathematics c) Equivalent MOOC course	MCS1T03
II	Elective 2	a) R Programming b) Neural Network c) Equivalent MOOC course	MCS2T07
III	Elective 3	a) Computer Graphics b) Internet of Things (IOT) c) Equivalent MOOC course	MCS3T11
IV	Elective 4	a) Design and Analysis of Algorithm b) Cyber Forensics a) Equivalent MOOC course	MCS4T15

The students can opt either the elective paper taught in the department in offline mode or any other equivalent online course of at least 4 credits offered by MOOC or any other such platform. The student should submit the passing certificate to the College in order to include the marks in the marksheet. **The MOOCs which is identical to courses offered in this scheme of M.Sc. Computer Science (in terms of contents) and are accessible to the student shall not be allowed for credit transfer.**

The objectives of the Program

1. To produce outstanding Computer Scientists who can apply the theoretical knowledge into practice in the real world and develop standalone live projects themselves.
2. To provide opportunity for the study of modern methods of information processing and its applications.
3. To develop among students the programming techniques and the problem solving skills through programming

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The ability to apply theoretical foundations of Computer Science and problem-solving skills through programming techniques for complex real time problems using appropriate data structures and algorithms.
2. The ability to design/develop hardware and software interfaces along with database management to meet the needs of industry.
3. The ability to demonstrate personal, organizational and entrepreneurship skills through critical thinking, engage themselves in life-long learning by following innovations in business, science & technology
4. Ethics on Profession, Environment and Society: Exhibiting professional ethics to maintain the integrality in a working environment and also have concern on societal impacts due to computer-based solutions for problems.

M. Sc. (Computer Science)
Semester I

MCS1T01
Paper I: ARTIFICIAL INTELLIGENCE

Hours/Week : 4
Credits : 4

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history.
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems.
3. To develop intelligent systems by assembling solutions to concrete computational problems

Course Outcomes:

- Evaluate Artificial Intelligence (AI) methods and describe their foundations.
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
- Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
- Analyze and illustrate how search algorithms and planning play vital role in problem solving.

UNIT I

AI problems, AI Techniques, Tic-tac-toe, Question Answering, Problem as a state space search, A water jug problem, production system, Control strategies, Heuristic Search, Problem Characteristics, Production system characteristics, Design of search programs AI Search techniques :- Depth-first, Breadth-first search, Generate-and-test, Hill climbing, Best-first search, Constraint satisfaction, Mean-ends-analysis, A* Algorithm, AO* algorithm.

UNIT II

Knowledge Representation:- Representations and mappings, Knowledge Representations, Issues in Knowledge Representation, Predicate Logic:- Representing Instance and Isa Relationships, Computable Functions and predicates, Resolution, Natural Deduction, Logic programming, Forward versus Backward Reasoning, Matching, Control knowledge, Expert System.

UNIT III

Games playing: Minimax search procedure , adding alpha-beta cutoffs, additional refinements, Planning :- Component of a planning system, Goal task planning, Nonlinear planning, Hierarchical Planning.

UNIT IV

Understanding, Understanding as Constraint satisfaction, Natural Language Processing, Syntactic Processing, Unification grammars, Semantic Analysis, Introduction to pattern recognition, Parallel and Distributed AI, Psychological Modeling, Distributed Reasoning Systems.

Books:

1. Artificial Intelligence by Elaine Rich, Mcgrawhill Inc.
2. Artificial Intelligence and Expert Systems – Jankiraman, Sarukes (M)
3. Lisp Programming – RajeoSangal – (TMH)
4. Artificial Intelligence – Russell-Pearson- Ist Text book.
5. Principles of AI- Nils Nilson
6. A.I. by R.J.Winston - Pearson

M. Sc. (Computer Science)
Semester I

MCS1T02
Paper II: COMPILER CONSTRUCTION

Hours/Week : 4
Credits : 4

Course Objectives:

1. To gain knowledge on Language Processor.
2. Distinguish different computing models and classify their respective types
3. Show a competent understanding of the basic concepts of Syntax Analysis.

Course Outcomes:

- Demonstrate the knowledge of Lexical Analysis
- Derive an appropriate model of code generation.

UNIT I

Introduction: Language Processors, the structure of a compiler, Lexical Analysis, Syntax Analysis, Semantic Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Symbol Table Management, The Grouping of Phases into Passes, Compiler-Construction Tools.Evolution of Programming Languages: The Move to High-Level languages, Impact on Compilers, Applications of Compiler Technology, Programming Language Basics

UNIT II

A Simple Syntax-Directed Translator: Introduction, Syntax Definition, Syntax-Directed Translation, Parsing:Top-Down Parsing, Predictive Parsing.
Lexical Analysis: The role of the lexical analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens: Transition Diagrams, Recognition of Reserved Words and Identifiers, The Lexical-Analyzer Generator 'Lex'.

UNIT III

Syntax Analysis: Introduction, Context-free grammars: The Formal Definition, Notational Conventions, Derivations and parse trees, Ambiguity, Writing a Grammar, Top-Down Parsing: Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing, Bottom-Up Parsing: Reductions, Handle Pruning, Shift-Reduce Parsing.
Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code, Types and Declarations: Type Expressions, Type Equivalence, Declarations, Type Checking: Rules, Type Conversions, Control Flow: Boolean Expressions, Short-Circuit Code, Flow-of-Control Statements, Control-Flow Translation of Boolean Expressions, Backpatching.

UNIT IV

Run-Time Environments: Storage Organization, Stack Allocation of Space, Heap Management.
Code Generation: Issues in Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs: Basic Blocks, Flow Graphs, Representation of Flow Graphs, Optimization of Basic Blocks: The DAG Representation of Basic Blocks, Finding Local Common Subexpressions, Dade Code Elimination, The use of Algebraic Identities, Representation of Array References. Peephole Optimization: Eliminating Redundant Loads and Stores, Eliminating Unreachable Code, Flow-of-Control Optimization.

Books:

1. Principles of Compiler Design - A.V. Aho, M. S. Lam, Ravi Sethi, J. D. Ullman, Second Edition, Pearson Education Inc.
2. Principles of Compiler Design - A.V. Aho, J. D.Ullman : Pearson Education.
3. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
4. Engineering a Compiler-Cooper & Linda, Elsevier.
5. Compiler Construction, Louden, Thomson.

M. Sc. (Computer Science)
Semester I

Elective I: MCS1T03
Paper III: COMPUTER ARCHITECTURE AND ORGANIZATION

Hours/Week : 4
Credits : 4

Course Objectives:

1. To provide knowledge on overview of IAS computer function and addressing modes.
2. Hardware and software implementation of arithmetic unit to solve addition, subtraction, multiplication and division.
3. To provide knowledge of memory technologies, interfacing techniques and sub system devices.

Course Outcomes:

- Provide fundamentals on machine instructions and addressing modes.
- Comprehend the various algorithms for computer arithmetic.
- Analyse the performance of various memory modules in memory hierarchy.
- Compare and contrast the features of I/O devices and parallel processors.
- Outline the evaluation of memory organization.
- Analyse the performance of Arithmetic logic unit, memory and CPU.

UNIT I

Principle of computer design : Software, hardware interaction, layers in computer architecture, central processing and machine language instruction, addressing modes, instruction types, instruction set selection, instruction and execution cycle.

UNIT II

Control Unit: Data path and control path design, microprogramming v/s hardwired control, pipelining in CPU design, RISC v/s CISC, superscalar processors.

UNIT III

Memory subsystem: Storage technologies, memory array organization, memory hierarchy, interleaving, cache memory and virtual memory including architectural aids to implement these.

UNIT IV

Input/ Output Processing: Bus Interface, Data transfer techniques, I/O interrupts and channels, Performance evaluation: SPEC marks, Transaction Processing Benchmarks.

Books:

1. Computer Architecture and Organization by Tenenbaum
2. Computer Architecture and Organization by J. P. Hayes.
3. Parallel Processing by Hwang
4. Computer Organization by Hamacher, Vranesic, Zaky (TMH)

M. Sc. (Computer Science)
Semester I

Elective 1: MCS1T03
Paper III: DISCRETE MATHEMATICAL STRUCTURE

Hours/Week : 4
Credits : 4

Course Objectives:

1 To cover certain sets, functions, relations and groups concepts for analyzing problems that arise in engineering and physical sciences.
2 To imparting to analyze the problems connected with combinatorics and Boolean algebra.
3 To solve calculus and integral calculus problems.

Course Outcomes:

- Observe the various types of sets, functions and relations.
- Understand the concepts of group theory.
- Understand the concepts of combinatorics.
- Understand the concepts of graph theory and its applications.
- Learning logic and Boolean algebra. Using these concepts to solve the problems

UNIT I

Mathematical Logic: Propositional Calculus: Connectives, statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, duality law, Tautological Implications, functionally complete set of connectives, other connectives. **Normal Forms**: CNF, DNF, PCNF, PDNF.

UNIT II

Fundamentals: Sets and Subsets, operations on sets, sequences, Division of the integer, Matrices, Methods of Proof, Mathematical Induction.
Counting: Permutations, Combinations, The pigeonhole Principle, Recurrence Relations.

UNIT III

Relations and Digraphs: Product sets and Partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations, Operations of Relations, Transitive Closure and Warshall's Algorithms.
Functions: Definition and Introduction, Permutation Functions, Growth of Functions.

UNIT IV

Order Relations and Structures: Partially Ordered Sets, Lattices.
Graph Theory: Basic Concept of Graph Theory, Euler Paths and Circuits, Hamiltonian Paths and Circuits.
Tree: Introduction, Undirected Tree, Minimal Spanning Trees.
Semigroups and Groups: Binary Operations Revisited, Semigroups, Products and Quotients of Groups.

Books:

1. Discrete Mathematical Structures By Bernard Kolman, Busby & Sharon Ross [PHI].
2. Discrete Mathematical Structures with Application to computer science By J. P. Tremblay & R. Manohar [Tata McGraw –Hill]
3. Discrete Mathematics with Graph Theory by Goodaire[PHI]
4. Discrete Mathematics by J.K.Sharma(McMillan)
5. Discrete Mathematics and its Applications by Kenneth Rosen (TMH)

M. Sc. (Computer Science)
Semester I

MCS1T04

Paper IV: RESEARCH METHODOLOGY

Hours/Week : 4
Credits : 4

Course Objectives:

1. To study and understand the research issues & challenges, research goals, scientific methods.
2. To study processing and analysis of data, Quantitative and Qualitative data analysis.
3. Reviewing Literature and research papers, writing research papers, Thesis reports.

Course Outcomes:

- The basic concept of research and its methodologies, Identify appropriate research topics, select and define appropriate research problem and parameters.
- Prepare a project (to undertake a project)
- Organize and conduct research in a more appropriate manner, writing research report and thesis.

UNIT I

Introduction: meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research processes, criteria of good research, **Defining Research Problem:** necessity of defining the problem, techniques involved in defining a problem, **Research Design**: meaning of research design, need for research design, features of good design, different research designs, basic principles of experimental design.

UNIT II

Methods of Data Collection: Collection of primary data, Observation method, Methods of Data collection, Interview Method, Collection of data through questionnaire, Collection of data through schedules, Difference between questionnaire and schedules. **Processing and Analysis of Data:** Processing operations, Problems in processing, Types of Analysis, Statistics in Research, Simple Regression analysis, multiple correlation and regressions, Partial correlation. **Quantitative Data analysis:** Types of quantitative data, data coding, visual aids for quantitative data analysis using statistics for quantitative data analysis, Interpretation data analysis result, evaluating quantitative data analysis, **Qualitative Data analysis:** Analyzing textual data, analyzing non-textual qualitative data, Grounded theory, computer aided qualitative analysis, evaluating qualitative data analysis.

UNIT III

Interpretation and Report Writing: Techniques of Interpretation, Significance of Report Writing, Different steps in Writing report, Layout of research report, type of report, oral presentation, mechanics of writing a research report **Python Tools:** File Handling, Introduction, Handling Binary data and CSV files, Zipping and Unzipping files, Directory **Regular Expression and Web scraping:** Introduction, Function of Re Module, web scraping.

UNIT IV

LaTeX: Writing scientific report, structure and components of research report, revision and Refining, writing project proposal, paper writing for international journals, submitting to editors conference presentation, preparation of effective slides, pictures, graphs and citation styles.

Books:

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. Briony J. Oates, Researching Information Systems and Computing, SAG Publication India Pvt. Ltd., New Delhi.
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, Python Programming: A Practical Approach, First edition published 2022 by CRC Press.
4. F. Mittelbach and M. Goossens, The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

M. Sc. (Computer Science)
Semester II

MCS2T05
Paper I: CLOUD COMPUTING

Hours/Week : 4
Credits : 4

Course Objectives:

1. To Understand fundamentals of cloud computing
2. To acquire good working knowledge of the essentials of Cloud Micro Services
3. To implement business specific cloud applications

Course Outcomes:

- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
- Compare the advantages and disadvantages of various cloud computing platforms.
- Program data intensive parallel applications in the cloud.
- Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
- Identify security and privacy issues in cloud computing.

UNIT I

Origins and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Intercloud, Types of Clouds, Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology. Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.

UNIT II

Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Understanding Core OpenStack Ecosystem. Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications (Social Networking, E-mail, Office Services, Google Apps, Customer Relationship Management).

UNIT III

Basic Terms and Concepts, Threat Agents, Cloud Security Threats and Attacks, Additional Considerations, Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Hardened Virtual Server Images. Cloud Issues: Stability, Partner Quality, Longevity, Business Continuity, Service-Level Agreements, Agreeing on the Service of Clouds, Solving Problems, Quality of Service, Regulatory Issues and Accountability. Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud.

UNIT IV

Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking, How the Cloud Will Change Operating Systems,

Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing.Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
2. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN :978 9332535923, 9332535922, 1st Edition.
3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN :9788131776513.
4. Brian J.S. Chee and Curtis Franklin, Jr., Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, CRC Press, ISBN :9781439806128.
5. Kris Jamsa, Cloud Computing: Saas, Paas, Iaas, Virtualization, Business Models, Mobile, Security, and More, Jones and Bartlett, ISBN :9789380853772.
6. John W. Ritting house, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press, ISBN : 978 1439806807, 1439806802.

M. Sc. (Computer Science)
Semester II

MCS2T06
Paper II: MACHINE LEARNING

Hours/Week : 4
Credits : 4

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes:

- Understand the concepts of various machine learning strategies.
- Handle computational data and learn ANN learning models.
- Solve real world applications by selecting suitable learning model.
- Boost the performance of the model by combining results from different approaches.

UNIT I

Learning: Types of Machine Learning, Supervised Learning, The Brain and the Neuron, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Linear Discriminants, Perceptron, Linear Separability, Linear Regression.

UNIT II

Multi-layer Perceptron: Going Forwards, Going Backwards: Back Propagation Error, Multilayer Perceptron in Practice, Examples of using the MLP, Overview, Deriving Back Propagation, Radial Basis Functions and Splines, Concepts, RBF Network, Curse of Dimensionality, Interpolations and Basis Functions, Support Vector Machines.

UNIT III

Learning with Trees: Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Probability and Learning, Data into Probabilities, Basic Statistics, Gaussian Mixture Models, Nearest Neighbor Methods, Unsupervised Learning, K means Algorithms, Vector Quantization, Self-Organizing, Feature Map

UNIT IV

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Isomap, Least Squares Optimization, Evolutionary Learning, Genetic algorithms, Genetic Offspring: Genetic Operators, Using Genetic Algorithms, Reinforcement Learning, Overview, Getting Lost Example, Markov Decision Process, Graphical Models: Markov Chain Monte Carlo Methods, Sampling, Proposal Distribution, Markov Chain Monte Carlo, Graphical Models, Bayesian Networks, Markov Random Fields, Hidden Markov Models, Tracking Method

Books:

1.Introduction to Machine Learning (Adaptive Computation and Machine Learning Series),EthemAlpaydin,Third Edition, MIT Press

2.Machine learning – Hands on for Developers and Technical Professionals, Jason Bell, Wiley

3.Machine Learning: The Art and Science of Algorithms that Make Sense of Datal, Peter Flach,Cambridge University Press.

4.Deep Learning , Rajiv Chopra, Khanna Publi.

5.Machine Learning, V. K. Jain, Khanna Publi

M. Sc. (Computer Science)
Semester II

Elective 2: MCS2T07
Paper III: R PROGRAMMING

Hours/Week : 4
Credits : 4

Course Objectives:

1. This course introduces R, which is a popular statistical programming language.
2. The course covers data reading and its manipulation using R, which is widely used for data analysis. It also covers different control structures and design of user-defined functions, Loading, installing and building packages .

Course Outcomes:

- Develop an R script and execute it
- Install, load and deploy the required packages, and build new packages for sharing and reusability 3. Extract data from different sources using API and use it for data analysis
- Visualize and summarize the data
- Design application with database connectivity for data analysis

UNIT I

Introduction, How to run R, R Sessions, Introduction to Functions, Important R Data - Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

UNIT II

R Programming Structures, Control Statements, Loops, Looping Over Non, vector Sets, If Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return Returning Complex Objects, Functions are Objective, No Pointers in R Recursion, A Quicksort Implementation Extended, Example: A Binary Search Tree.

UNIT III

Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability Cumulative Sums and Products Minima and Maxima Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /Output, Accessing the Keyboard and Monitor, Reading and writer Files.

UNIT IV

Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot () Function – Customizing Graphs, Saving Graphs to Files, Probability Distributions, Normal Distribution Binomial Distribution Poisson Distributions other Distribution, Basic Statistics, Correlation and Covariance.

Books:

1. The Art of R Programming, Norman Matloff, Cengage Learning
2. Cotton, R., Learning R: a step by step function guide to data analysis. 1st edition.O'reilly Media Inc.
3. R for Everyone, Lander, Pearson Siegel, S. (1956), Nonparametric Statistics for the Behavioral Sciences, McGrawHill International, Auckland.

M. Sc. (Computer Science)
Semester II

Elective 2: MCS2T07
Paper III: NEURAL NETWORK

Hours/Week : 4
Credits : 4

Course Objectives:
1. To introduce the foundations of Artificial Neural Networks
2. To learn various types of Artificial Neural Networks

Course Outcomes:
- Ability to understand the concepts of Neural Networks.
- Ability to select the Learning Networks in modeling real world systems

UNIT I
Introduction: Feedforward Neural Networks: Artificial Neurons, Neural Networks and Architectures: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Network Geometry of Binary Threshold Neurons and Their Network: Patterns Recognition and Data Classification, Convex Sets, Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are pattern Dichotomizes, Non-linearly separable Problems, Capacity of a simple Threshold Logic Neuron, Revisiting the XOR Problem, Multilayer Networks.

UNIT II
Supervised Learning I: Perceptrons and LMS: Learning and Memory, From Synapses to Behaviour: The Case of Aplysia, Learning Algorithms, Error Correction and Gradient Descent Rules, The Learning Objective for TLNs, Pattern space and Weight Space, Perceptron Learning Algorithm, Perceptron Convergence Theorem, Perceptron learning and Non-separable Sets, Handling Linearly Non-Separable sets, α-Least Mean Square Learning, MSE Error Surface and its Geometry, Steepest Descent Search with Exact Gradient Information, μ-LMS: Approximate Gradient Descent, Application of LMS to Noise Cancellation

UNIT III
Supervised Learning II: Backpropagation and Beyond: Multilayered Network Architectures, Backpropagation Learning Algorithm, Structure Growing Algorithms, Fast Relatives of Backpropagation, Universal Function Approximation and Neural Networks, Applications of Feedforward Neural Networks, Reinforcement Learning

UNIT IV
Neural Networks: A Statistical Pattern Recognition Perspective: Introduction, Bayes Theorem, Classification Decisions With Bayes Theorem, Probabilistic Interpretation Of A Neuron Discriminant Function, Interpreting Neuron Signals As Probabilities, Multilayered Networks, Error Functions And Posterior Probabilities, Error Functions For Classification Problems

Generalization: Support Vector Machines and Radial Basis Function Networks: Learning from Examples and Generalization, Statistical Learning Theory Briefer, Support Vector Machines, Radial Basis Function Networks, Regularization Theory Route to RRBFNs, Generalized Radial Basis Function Network, Learning In RRBFNs, Image Classification Application, Other Models for Valid Generalization

Books:

1. Neural Network- A Classroom Approach, Satish Kumar, Tata McGraw Hill
2. Introduction to neural networks using MATLAB 6.0 by Sivanandam, S Sumathi, S N Deepa, Tata Megraw Hill
3. Neural networks A comprehensive foundations, Simon Hhaykin, Pearson Education 2nd edition 2004
4. Artificial neural networks - B.Yegnanarayana, Prentice Hall of India P Ltd 2005.
5. Neural networks in Computer intelligence, Li Min Fu, TMH 2003.
6. Neural networks James A Freeman David M S kapura, Pearson education 2004.

M. Sc. (Computer Science)
Semester III

MCS3T08
Paper I: ADVANCED SOFTWARE ENGINEERING

Hours/Week : 4
Credits : 4

Course Objective:
The course offers students to develop the ability to design software systems and analyse and test their performance.

Course Outcomes:
On successful completion of this subject students should be able to:

- To demonstrate an understanding of advanced knowledge of the practice of software engineering, design, validation, test and deployment.
- Use modern engineering principles, processes, and technologies to solve difficult engineering issues and tasks.
- Demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business.
- Identify the proper ethical, financial, and environmental effects of their work.

Unit I
Introduction to Software Engineering, Software Engineering as a Layered Technology, Software Development Life Cycle, Generic View of process, A process framework, Process Model – Waterfall, Incremental, Evolutionary, Unified Process Model, Agile Process Model, Scrum, Dynamic System development model, CMMI.

Unit II
System Models: Context Model, Behavioural Model, Data Model, Object Model, Modelling with UML, Design Engineering: Design Process, Design Quality, Design Concepts: Abstraction, Architecture, Patterns, Information Hiding, Functional Independence, Modularity, Design Model: OO Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Unit III
Testing Strategies, Strategic Approach to software testing: Verification, Validation, Error, Fault, Bug, Failure. Types of software testing: Unit Testing, White Box Testing, Black Box Testing, Software Quality Assurance: Software Reliability, Risk Management: Reactive, Proactive risk, Risk Identification, Risk Projection, Risk Refinement, RMMM plan.

Unit IV
Software Metrics: Software Sizing, LOC, FP Based estimations, estimation model, COCOMO Model, Project Scheduling, Time Line Chart, Software Configuration Management: Change Control and version control, software Reuse, Software Re-engineering, Reverse Engineering.

Books:
1. Software Engineering: A Practitioner's Approach, Roger Pressman, Macgraw Hill International Edition.
2. Fundamentals of Software Engineering, Carlo Gheezzi, Mehdi Jazayeri, Dino Mandrioli, PHI Publication.

M. Sc. (Computer Science)
Semester III

MCS3T09
Paper II: NETWOR SECURITY

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on Network security, various encryption techniques, and intrusion detection and the solutions to overcome the attacks.

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify the symmetric encryption techniques
- Illustrate various Public key cryptographic techniques
- Evaluate the authentication and hash algorithms.
- Basic concepts of system level security

Unit I

Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Nonrepudiation, Cryptographic Techniques.

Unit II

Principles of Cryptography Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard, Key distribution, Attacks. Public key Cryptography RSA, Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures.

Unit III

PKI and Security Practices Digital Certificates, MD5, SHA, Challenge Response protocols-Authentication applications, Kerberos, X.509, Securing Email, Web Security.

Unit IV

Software Vulnerabilities Buffer Overflow, Cross Site Scripting, SQL Injection, Case Studies on worms and viruses, Virtual Private Networks, Firewalls **Wireless Security** Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things

Books:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education, 7th edition, 2016.
2. Behrouz A. Forouzan, Cryptography and networksecurityMCGrawHill3rdEdition
3. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books:

1. Applied Cryptography - Schnier
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004.
3. E. Rescorla, "SSL and TLS: Designing and Building Secure Systems", Addison-Wesley, 2001.
4. B.L. Menezes, "Network Security and Cryptography", Wadsworth Publishing Company Incorporated, 2012.
5. Handbook of Applied Cryptography - Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone: Online Version

M. Sc. (Computer Science)
Semester III

MCS3T10
Paper III: DIGITAL IMAGE PROCESSING

Hours/Week : 4
Credits : 4

Course Objective: The course offers the students to develop the ability to understand image analysis algorithms and current applications in the field of digital image processing.

Course Outcomes:

On successful completion of this subject students should be able to:

• Know and understand the basics and fundamentals of digital image processing, digitization, sampling, quantization, and 2D-transforms.

• Operate on images using the techniques of smoothing, sharpening and enhancement. Understand the restoration concepts and filtering techniques.

Unit I

Fundamentals of Digital Image Processing:

Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, Color image fundamentals, RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Unit II

Image Enhancement: Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform, Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Unit III

Image Restoration: Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering

Unit IV

Image Segmentation: Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Morphological processing- erosion and dilation, Segmentation by morphological watersheds, basic concepts, Dam construction, Watershed segmentation algorithm.

Books:

1. Rafael C. Gonzalez, Richard E. Woods,'_Digital Image Processing', Pearson, Third Edition, 2010.
Anil K. Jain, _Fundamentals of Digital Image Processing', Pearson, 2002.
2. Kenneth R. Castleman, _Digital Image Processing', Pearson, 2006.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, _Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
4. D.E. Dudgeon and RM. Mersereau, _Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
5. William K. Pratt, _Digital Image Processing', John Wiley, New York, 2002.
6. Milan Sonka et al _Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

M. Sc. (Computer Science)
Semester III

Elective 3: MCS3T11
Paper IV: COMPUTER GRAPHICS

Hours/Week : 4
Credits : 4

Course Objective:

1. To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
2. To make the student present the content graphically.

Course Outcomes:

On successful completion of this subject students should be able to:

- Students can animate scenes entertainment.
- Will be able to work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

Unit I

Introduction of computer Graphics and its applications. Overview of Graphics systems, Video display devices, Raster scan display, Raster scan systems, video controller, Raster scan display processor, Random scan display, random scan systems, color CRT monitor, Flat panel display, Interactive input devices, Logical classification of input devices, Keyboard, mouse, Trackball and spaceball, Joysticks, Image scanner, Light pens, Graphics software, Coordinates representations, Graphics functions.

Unit II

Line drawing algorithms, DDA, Bresenham's, Circle generating, Mid-point circle algorithm, Ellipse generating, Polygon , Scan-line polygon fill, Boundary fill.

Unit-3 : Basic transformation's, Translation, Rotation, Scaling, Matrix representation's & homogeneous coordinates, Composite transformation's, Reflection, Two dimensional viewing, Two dimensional clipping, Line, Polygon, Curve, Text. 3D-transformation, Projection, Viewing, Clipping. Spline representation, Cubic spline, Bezier curve, Bezier surfaces, Beta spline, B-spline surfaces, Bspline curve, Hidden surfaces, Hidden lines, Z-buffer.

Unit IV

Fractal's geometry Fractal generation procedure, Classification of Fractal, Fractal dimension, Fractal construction methods. Color models, XYZ, RGB, YIQ, CMY & HSV, Shading algorithms, Shading model, Illumination model, Gouraud shading, Phong shading.

Books:

1. Computer Graphics by M. Pauline Baker, Donald Hearn, 2 Edition PHI.
2. Mathematical Element for Computer Graphics By. David F. Roger., J. Alan Adams, 2nd Edition, Tata McGHill.

Reference Books:

1. Principles of Interactive Computer Graphics By. William. M. Newmann. 2nd Edition Mc. Graw Hill.
2. Procedural Element for Computer Graphics By. David F. Roger. Mc. Graw Hill.
3. Computer Graphics By A.P. Godse, 2nd Editio TPPublication,
4. Computer Graphics By V.K. Pachghare, 2nd Edition, Laxmi Publication 5. Computer Graphics By Apurva Desai (PHI)

M. Sc. (Computer Science)
Semester III

Elective 3: MCS3T11
Paper IV: INTERNET OF THINGS (IOT)

Hours/Week : 4
Credits : 4

Course Objective: The course offers to impart knowledge on IoT and protocols, it expose the student to some of the electrical application areas where Internet of Things can be applied..

Course Outcomes:

On successful completion of this subject students should be able to:

- Able to understand the application areas of IoT
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Able to understand building blocks of Internet of Things and characteristics.

UNIT I

Introduction to IoT: Overview of IoT, Types of Iot frameworks, IoT Ecosystem, Design patterns for IoT, Iol architectures such as four-layer architecture, seven-layer architecture. IoT sensors and actuators: Understanding the types of sensors: Temperature, humidity, proximity, light and actuators used in IoT devices: pump, servo motor and LED and their applications.

UNIT II

IoT communication protocols: Learning about various communication protocols such as MQTT, CoAP, HTTP, and their usage in IoT devices.

IoT platforms and cloud computing: Understanding IoT platforms: Cloud based IoT platform, Edge Based IoT Platform, On-Premises Cloud Platform, Cloud computing, IoT devices communication with cloud using Messaging, PUB/SUB, API, and their role in the deployment of IoT applications.

UNIT III

Data Analytics and Machine Learning for IoT: Data collection and Storage in IoT, Techniques and tools used for analyzing and processing data generated by IoT devices, including machine learning algorithms.

Security and Privacy in IoT: Understanding the security and privacy challenges in IoT and techniques for securing IoT systems.

UNIT IV

Overview of Arduino, Introduction to programming languages and IDEs, Basic electronics concepts (resistors, capacitors, LEDs, etc.), Introduction to breadboards and circuit design, Variables, data types, and control structures, Functions and libraries, Sensors and Actuators, Introduction to sensors (e.g., temperature, humidity, light), Introduction to actuators (e.g., motors, LEDs, relays), Connecting and controlling sensors and actuators with Arduino

Case Studies on IoT Applications For Smart Homes, Cities, Environment-Monitoring And Agriculture

Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Robert Barton, Jerome Henry
2. INTERNET OF THINGS Architecture and Design Principles, Raj Kamal, McGraw Hill Education (India) Private Limited
3. THE INTERNET OF THINGS KEY APPLICATIONS AND PROTOCOLS Olivier Hersent Actility, France David Boswarthick ETSI, France Omar Elloumi Alcatel-Lucent, France
4. Internet of Things -Architecture, Implementation and Security by Mayur Ramgir
5. Programming Arduino ™ Getting Started with Sketches Simon Monk

M. Sc. (Computer Science)
Semester IV

MCS4T12
Paper I: BIG DATA ANALYTICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers students to develop understanding towards the basic concepts of Big Data, adaptation and planning of Big Data and Business Intelligence

Course Outcomes:

On successful completion of this subject students should be able to:

- Classify and categorize different types of Data Analytics
- frame Business Architecture
- Understand the use of Information and Communication Technology
- Differentiate Between Traditional data Analysis and Big Data Analytics
- Evaluate different Enterprise Technologies and Big Data Business Intelligence

Unit I

Concepts and terminology: Data Sets, Data Analysis, Data Analytics, Descriptive, Diagnostic, Predictive, Prescriptive Analytics, Business Intelligence, Big Data Characteristics, Volume, Velocity, Variety, Veracity and Value. Different types of Data, Structured, Unstructured, Semi-Structured, Meta Data Business Motivations and Drivers for Big Data Adoption.

Unit II

Big Data Analytics Life cycle - Business Case Evaluation, Data Identification, Data Acquisition and Filtering, Data Extraction, Data Validation and Cleansing, Data Aggregation and Representation, Data Analysis, Visualization, Utilization of Analysis Results.

Unit III

Enterprise Technologies - OLTP, OLAP, ETL Big Data BI, Clusters, Big Data Storage Concepts, Big Data Processing Concepts, Big Data Storage Technology - On Disk Storage Devices, NOSQL Databases, In-Memory Storage Devices.

Unit IV

Big Data Analysis Techniques - Quantitative, Qualitative, Statistical Analysis, Semantic Analysis, Visual Analysis, Introduction to Hadoop, Map Reduce, Hive, Pig, Spark and Big Data Analytics.

Books:

1. Big Data Fundamentals Concepts, Drivers & Techniques Thomas ErL, Wajid Khattak and Paul Buhler, Pearson Publication 2022.
2. Big Data Analytics Introduction to Hadoop, Spark and Machine-Learning, RajKamal, Preeti Saxena, McGraw Hill Publication, 2019.

M. Sc. (Computer Science)
Semester IV

MCS4T13
Paper II: COMPUTER VISION

Hours/Week : 4
Credits : 4

Course Objective: The course offers to introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.

Course Outcomes:

On successful completion of this subject students should be able to:

- Implement fundamental image processing techniques required for computer vision.
- Develop computer vision applications.

Unit I

Recognition Methodology: Conditioning, Labeling, Grouping, Extracting, Matching. Edge detection, Gradient based operators, Morphological operators, Spatial operators for edge detection, Thinning, Region growing, region shrinking, Labeling of connected components.

Unit II

Binary Machine Vision: Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation.

Unit III

Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting). **Region Analysis**: Region properties, External points, Spatial moments, Mixed spatial gray-level moments, Boundary analysis: Signature properties, Shape numbers.

Unit IV

Facet Model Recognition: Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking, Perspective Projective geometry, Inverse perspective Projection, Photogrammetry - from 2D to 3D, Image matching: Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching.

Books:

1. David A. Forsyth, Jean Ponce,"Computer Vision: A Modern Approach"
2. R. Jain, R. Kasturi, and B. G. Schunk, "Machine Vision", McGraw-Hill.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, 'Image Processing, Analysis, and Machine Vision" Thomson Learning.
4. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison- Wesley, 1993.

M. Sc. (Computer Science)
Semester IV

MCS4T14
Paper III: DEEP LEARNING

Hours/Week : 4
Credits : 4

Course Objectives: The course offers to understand major deep learning algorithms and to identify deep learning techniques suitable for a given problem.

Course Outcomes:

On successful completion of the course students will be able to:

- Solve various deep learning problems
- Apply autoencoders for unsupervised learning problems
- Implement Convolutional Neural Networks to image classification problems
- Apply recurrent neural network to sequence Learning Problem.

Unit I

Introduction to Neural Networks: Feed Forward Neural Networks, Backpropagation , Gradient Descent (GD) Principal Component Analysis: Eigenvalues and eigenvectors, Eigenvalue Decomposition Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition.

Unit II

Autoencoders: Undercomplete Autoencoders, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Noise Robustness

Unit III

Convolutional Neural Networks: The Convolution Operation, Motivation, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation.

Unit IV

Recurrent Neural Networks: Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, LSTMs, GRUs, The Challenge of Long-Term Dependencies, Attention Mechanism.

Books:

1. Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
2. Deep Learning from Scratch, Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books:

1. Deep Learning by Ian Good fellow, Yoshua Bengio and Aaron Courville MIT press

M. Sc. (Computer Science)
Semester IV

Elective 4: MCS4T15
Paper IV: DESIGN AND ANALYSIS OF ALGORITHM

Hours/Week : 4
Credits : 4

Course Objective: The course offers students to develop the ability to design, analyse and synthesize the important algorithmic design paradigms.

Course Outcomes:

On successful completion of this subject students should be able to:

- Produce thorough proofs of an algorithm's soundness.
- Demonstrate about important algorithms and data structures.
- Use key analytical techniques and concepts for algorithmic design.
- Combine effective algorithms in typical engineering design scenarios.

Unit I

Definition of Algorithm & its characteristics, Recursive and Non-recursive Algorithms, Time & Space Complexity, Definitions of Asymptotic Notations, Insertion Sort (examples and time complexity), Heaps & Heap Sort (examples and time complexity). **Divide & Conquer:** Concept of divide and Conquer, Binary Search (recursive), Quick Sort, Merge sort.

Unit II

Greedy Algorithm: Fractional Knapsack problem, Optimal Storage on Tapes, Huffman codes, Concept of Minimum Cost Spanning Tree, Prim's and Kruskal's Algorithm.

Unit III

Dynamic Programming: The General Method, Principle of Optimality, Matrix Chain Multiplication, 0/1 Knapsack Problem, Concept of Shortest Path, Single Source shortest path, Dijkstra's Algorithm, Bellman Ford Algorithm, Floyd- Warshall Algorithm, Travelling Salesperson Problem.

Unit IV

Branch & Bound: Introduction, Definitions of LCBB Search, Bounding Function, Ranking Function, FIFO BB Search, Traveling Salesman problem Using Variable tuple. Decrease and Conquer: Definition of Graph Representation, BFS, DFS, Topological Sort/Order, Strongly Connected Components, Biconnected Component.

Books:

1. Fundamentals of Computer Algorithms, Authors - Ellis Horowitz, Sartaz Sahani, Sanguthevar Rajsekaran Publication: - Galgotia Publications
2. Introduction to Algorithms (second edition) Authors: - Thomas Cormen, Charles E Leiserson, Ronald L.Rivest , Clifford Stein ,Publication: - PHI Publication

M. Sc. (Computer Science)
Semester IV

Elective 4: MCS4T15
Paper IV: CYBER FORENSICS

Hours/Week : 4
Credits : 4

Course Objective: The course offers to Identify, gather, and preserve the proof of a law-breaking and to track and prosecute the perpetrators in an exceedingly court of law.

Course Outcomes:

On successful completion of this subject students should be able to:

- To learn investigation tools and techniques, analysis of data to identify evidence.
- To analyze the technical Aspects & Legal Aspects related to cyber crime.

Unit I

Recent amendments in IT Act, internet & web technologies, web hosting and development, attributes in cyberspace and legal framework of cyberspace, hacking, virus, obscenity, pornography, programme manipulation, Copyright, Patent, software piracy, intellectual property rights, trademark, domain disputes, and computer security, etc., Encryption and Decryption methods. Search and seizures of evidence. Investigation of cyber crimes and tools for analysis.

Unit II

Information security: Domains, Common Attacks, Impact of Security Breaches, Protecting Critical Systems (Information Risk Management, Risk Analysis etc) Information Security in Depth Physical security (Data security Systems and network security) Program Security: Secure programs, Non-malicious program errors, Viruses and other malicious code, Targeted malicious code, Controls against program threats File protection mechanism, Authentication: Authentication basics, Password, Challenge response, Biometrics. Network Security: Threats in networks, Network security control, Firewalls, Intrusion detection systems, Secure e-mail, Networks and cryptography, Example protocols: PEM, SSL, IPsec. Principles of network forensics, Attack Trace-back and attributes, Critical Needs Analysis. IDS: Network based Intrusion Detection and Prevention Systems, Host based Intrusion Prevention System. Cloud Computing-Its Forensic and Security Aspects.

Unit III

Cyber Crime Investigations: Where Evidence Resides on Windows systems, Conducting a Windows investigation, File Auditing and Theft of information, Handling the Departing Employee, Steps in a Unix Investigation, Reviewing Pertinent Logs, Performing Keywords Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships, Detecting Trojan Loadable Kernel Models, Finding Network based Evidence, Generating Session data with TCP Trace, Reassembling sessions using TCP flow and Ethereal.

Unit IV

Open source tools for digital forensics and Registry Forensic- Open source, Open source examination platform, preparing the examination system, using LINUX and Windows as host, Study of Sleuth Kit: Installing Sleuth Kit, Sleuth Kit tools (Volume layer tools, File system Layer tools, Data unit Layer tools, Metadata Layer Tools) Registry Analysis, Understanding Windows Registry and Registry Structure.

Books:

1. C. P. Pfleeger, and S. L. Pfleeger, "Security in Computing", Pearson Education,

2. Computer Forensic Investigating Data and Image Files, EC Council Press
3. Robert Jones, Internet Forensics Using Digital Evidence to Solve Computer Crimes, O'Reilly Media Publication
4. Forouzan Data Communication and Networking McGraw Hill
5. Stallings, "Cryptography And Network Security: Principles and practice"
6. Kevin Mandia, Chris Prosise and Matt Pepe, Incident response and computer forensics, McGraw Hill Publication
7. Cory Altheide, Harlan Carvey, Digital Forensics with Open source Tools, Syngress Publication
8. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003
9. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC 28 Press LLC, 2004.

Two Year Master of Commerce (M. Com.) Degree Examination

Scheme of Examination for Two Year Master of Commerce (M.Com.) Program from Academic Session 2023-24

Preamble:

The Academic Council of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur has adopted the Government Resolution No. NEP-2022/प्र.क्र.09/विशी-3/शिकाना dated 16th May 2023 issued by the Government of Maharashtra in its meeting held on 5th June 2023 in view of implementation of National Education Policy, 2020. The teaching and examination scheme for Master of Commerce (M. Com.) program has been prepared by the 'Task Force' constituted for the purpose by Hon'ble Vice-Chancellor, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur and is approved by all Boards of Studies under the Faculty of Commerce and Management in a meeting scheduled on 4th July 2023.

1. **Details of eligibility for M.Com. semester 1 examination**

A) For the **M.Com. 1st Semester,** the examinee shall have Passed the B. Com or B. Com with Computer Applications or BBA degree examination of Rashtrasant Tukadoji Maharaj Nagpur University or any other equivalent degree of any other recognized university;

B) The course leading to the Master Degree in Commerce being full time regular course in nature, the students enrolled for this course shall not be permitted to join any other course in this University or any other University simultaneously.

2. **Duration of the Program, student progression path and provisions for Multiple Entry and Exit**
   a. Duration of the M. Com. Program shall be TWO years with the provision for multiple exit as mentioned here:
      a. A student can exit the program after successful completion of 1st and 2nd semesters having earned requisite number of credits as mentioned in the scheme of examination. Such a student shall be eligible for the award of 'Post Graduate Diploma in Commerce' with a major by the University.
      OR
      a student can continue the program in 2nd year in order to become eligible for the award of 'Master of Commerce' degree with a major subject by the university.
   b. Re-entry or Lateral Entry
      a. Students, opting for exits at any level, will have the option to re-enter the programme from where they have left off, in the same or in a different higher education institution within three years of exit and complete the degree programme within the stipulated maximum period of SEVEN years from the date of admission to first year.
      b. Re-entry at various levels for lateral entrants in academic programmes shall be based on the earned and valid credits as deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher Education Institutions and proficiency test records.
      c. Lateral entry into the programme of study leading to the UG Diploma / Three Year UG Degree / Four Year Bachelor's Degree with Honours/Research will be based on the validation of prior learning outcomes achieved and subject to availability seats based on intake capacity.

Semester Completion	No. of Minimum Credits Required	Additional Credit Requirement	Eligible For
I and II	40	Nil	Post Graduate Diploma in Commerce with Major
III and IV	82	Nil	Master of Commerce Degree with Major

3. **Selection of 'Major' Subject**
   A student admitted to this program is required to select any one of the following subjects as 'Major' subject to the availability of a particular subject in a particular college and is required to undergo and successfully complete the 'Core' and 'Elective' courses as mentioned in the scheme of examination of the selected 'Major' subject.

4. **Availability of 'Major' and 'Intake Capacity'**
   All colleges affiliated to the University for offering **Master of Commerce (M. Com.)** Program/s in the Faculty of Commerce and Management shall adhere to the following:

Affiliated Program	Sanctioned Intake	'Major' to be offered
M. Com.	As approved by the University	• Accounting and Taxation • Business Studies • Industrial Relations • Computer Management

NOTES:
- Total intake capacity for the program as approved by the university shall remain the same and be divided amongst the 'Major' subjects allowed for M. Com. program.
- The COLLEGE may offer a particular 'Major' subject depending on the availability of students and teachers.
- The COLLEGE is not expected to force any student to opt for a particular subject where a choice is provided in the scheme of examination.

5. All colleges affiliated to the University offering B. Com. Program are required to put up a list of 'Major' and 'Minor' subjects it is offering on the Notice Board as well as on the website of the college to make students aware about the availability of subjects. Moreover, colleges are expected to define and display the 'Standard Operating Procedures' for the college staff members and students to facilitate the process of selecting 'Major' and 'Minor' subjects.

6. In pursuance with the National Education Policy 2020 and a Government Resolution No. NEP-2022/प्र.क्र.09/विशी-3/शिकाना dated 16th May 2023 issued by the Government of Maharashtra, the credit framework for B. Com. Program shall be as mentioned in **Annexure – I.**

7. **M. Com. Program Outcomes**

   a. Apply knowledge of theories and procedures related to accountancy, economics, management, and other allied areas to solve problems of business organizations.
   b. Foster Analytical and Critical thinking abilities for data-based decision making
   c. Ability to develop Value Based Leadership ability
   d. Ability to understand, analyze and communicate global, economic, legal, and ethical areas of business
   e. Ability to lead themselves and others in the achievement of organizational goals, contributing effectively to a team environment.

e. Ability to lead themselves and others in the achievement of organizational goals, contributing effectively to a team environment.

8. Research Methodology Course:

'Research Methodology' is a compulsory course and the curriculum and evaluation pattern is common for all 'Major Subject' **(Annexure – IV)**

9. Evaluation Scheme for OJT/FP/CEP and RP

A student of M. Com. Semester – II has to compulsorily undergo 'On Job Training' during a summer break after second semester. A 'Field Project' or 'Community Engagement Project' of same duration shall be considered as equivalent to OJT.

Similarly, a student of M. Com. Semester – III and IV is required to undertake a 'Research Project'.

Scope of these courses and their detailed evaluation scheme is appended in **Annexure – III.**

10. Teaching and Examination Scheme

Teaching and Examination Schemes for all available 'Major' subjects for Master of Commerce (M. Com.) degree are appended in **Annexure – II.**

11. Grade Conversion Table and Computation of SGPA and CGPA

Grade Conversion Table (Theory)

SN	Letter Grade	Grade Point	Mark Range	Performance
1	O	9.00 - 10.00	90 – 100	Outstanding
2	A+	8.00 - < 9.00	80 - < 90	Excellent
3	A	7.00 - < 8.00	70 - < 80	Very Good
4	B+	6.00 - < 7.00	60 - < 70	Good
5	B	5.50 - < 6.00	55 - < 60	Above Average
6	C	5.00 - < 5.50	50 - < 55	Average
7	P	4.00 - < 5.00	40 - < 50	Pass
8	F	Below 4	Below 40	Fail
9	AB	0	-	Absent

Grade Conversion Table (Practical)

SN	Letter Grade	Grade Point	Mark Range	Performance
1	O	9.00 - 10.00	90 – 100	Outstanding
2	A+	8.00 - < 9.00	80 - < 90	Excellent
3	A	7.00 - < 8.00	70 - < 80	Very Good
4	B+	6.00 - < 7.00	60 - < 70	Good
5	B	5.50 - < 6.00	55 - < 60	Above Average
6	P	5.00 - < 5.50	50 - < 55	Pass
7	F	Below 5	Below 50	Fail
8	AB	0	-	Absent

Computation of SGPA & CGPA:

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \Sigma(Ci \times Si) / \Sigma Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. CGPA to Percentage (%) conversion formula:

Percentage (%) = (CGPA) * 10

12. Credit Specifications:

a. Theory/Tutorial Courses: One hour/credit/week (a minimum of 15 hours of teaching per credit is required in a semester.
b. Laboratory/Performance Based Courses: A minimum of 30 hours in laboratory or Performance Based activities is required in a semester. Performance based activities include Studio activities, Workshop based activities, internship, Apprenticeship, Field based learning, community engagement learning, etc.
c. Each semester will consist of at least 15 weeks of Academic Work equivalent to 90 actual teaching days.

13. Assessment

- The final total assessment of examinees shall made in terms of Continuous Internal Assessment (CIE) for 20% component and Session End Examination (SEE) for 80% component for each THEORY course mentioned in the scheme of examination.
- 'On Job Training/SIP' being a PRACTICAL course shall be assessed at college/department level as per the 'Evaluation Rubrics' mentioned in **Annexure – III.**
- 'Research Project' being a PRACTICAL course shall be assessed at college/department level as per the 'Evaluation Rubrics' mentioned in **Annexure – III.**
- Expected Performance Based Activities shall consist of the following: (a) Group Discussion (b) Seminars (c) Power Point Presentations (d) Elocution (e) Debate (f) Role Play (g) Case Studies (h) Educational Games. The teacher is expected to undertake a minimum of four of the aforesaid activity.

Continuous Internal Assessment

1a	Attendance of the student during a particular semester	05 Marks
1b	An assignment based on curriculum to be assessed by the teacher concerned	05 Marks
1c	Subject wise class test or Performance Based Activities conducted by the teacher concerned	10 Marks
1	**Continuous Internal Evaluation Total marks**	**20**

- The CIE marks will be communicated to the University at the end of each semester, but before the semester end examinations / as instructed by the university. These marks will be considered for the declaration of the results.
- The record of CIE marks, evaluation & results should be maintained for a period of one year by the respective institute/college for verification by the competent authority.

14. Attainment of Course Outcomes

a. Continuous Internal Assessment shall be carried out at college/department level in such a way the attainment of prescribed learning outcomes can be measured. The college/department concerned is required to define evaluation rubrics for 'Performance Based Activities' conducted for CIE.

b. Semester End Examinations are conducted by the university. The question papers for these examinations are required to be set in such a way that the attainment of prescribed learning outcomes can be measured.

15. Standard of Passing

The scope of the subject, percentage of passing in Theory and Project and Internal Assessment will be governed as per following rules:

(i) In order to pass the Master of Commerce (MB.Com.) 1st, 2nd, 3rd and 4th Semester Examinations, an examinee shall obtain not less than 40 % (Grade 4) marks in each theory course/paper, taking CIE & SEE together. Whereas, for practical/performance-based examination an examinee shall obtain not less than 50 % (Grade 5) marks in each practical, taking CIE & SEE together. Moreover, a student is required to secure not less than 50% marks in aggregate i.e. taking all courses together in order to become eligible for the award of M. Com. degree.

(ii) An examinee who is unsuccessful at the examination shall be eligible for admission to the subsequent examinations on payment of a fresh fee prescribed for the examination together with the conditions of the ordinance in force from time to time.

16. Rules for ATKT (Allowed to Keep the Term):

An unsuccessful examinee at any semester examination shall be **ALLOWED TO KEEP TERM as per following conditions:**

Admission to Semester	**Eligibility for admission and taking University Examination**
Semester – I	Candidate should have passed the qualifying examination as per the relevant Direction governing the course.
Semester – II	Candidate should have completed the term of the Ist semester and filled examination form.
Semester – III	Candidate should have completed the term of the IInd semester, filled the examination form of the same and has obtained exemption in 2/3rd passing heads of the Ist and IInd semesters taken together.

Semester – IV	Candidate should have completed the term of the IIIrd semester and filled the examination form of the same.

17. Abbreviations Used:

CIE: Continuous Internal Evaluation SEE: Semester End Examination

OJT: On Job Training (Internship/Apprenticeship), RM: Research Methodology, RP: Research Project

18. Provision for Transfer of Credits

The M.Com. program offered under this direction provides enhanced academic flexibility to students in terms of selecting the courses they want to learn. A student can opt for any course from any statutory/recognized University or a MOOC from SWAYAM/NPTEL in lieu of a course mentioned in this scheme of examination as 'Elective' course. The mechanism for transfer of credits earned through these courses to be adhered is mentioned here;

1. Every student is mandatorily required to create an ID on Academic Bank of Credits (ABC) and shall submit her/his ID to the college.
2. Any Course mentioned in this scheme of examination under 'Elective' can be opted out by a student for taking a MOOC from SWAYAM/NPTEL learning platform.
3. A student cannot opt out any 'Core' course.
4. If a student is willing to opt out any 'Elective' course, he/she will have to mention this while submitting the examination form to the University for respective semester.
5. A certificate of completion of such an ODL/Online course shall be submitted by the student to the University through college before end term evaluation.
6. Such a certificate shall mandatorily have the number of credits, duration of the course and grades/marks obtained by the student and shall preferably have a QR code for verification.
7. The college shall submit the grades and marks obtained by the student to the University along with Internal Assessment marks for the concerned examination.
8. If a student has opted for an ODL/Online course in a particular semester and failed to submit the certificate within prescribed time, the student will be marked for 'Absent' for a particular course in that examination. Such a student will be required to fill in the examination form in the consecutive attempt and submit the passing certificate in order to get his/her corrected result.
9. A separate guideline 'Transfer of Credits' issued by the University will be applicable to the students of M. Com. Program from the date of its issuance.

NOTE: This scheme of teaching and examination for Two Year Master of Commerce (M. Com.) Program shall be effective from the academic session 2023-24 and a comprehensive direction for other regulations in this connection shall be soon issued by the University.

Annexure - I

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY

CREDIT FRAMEWORK FOR 2 YEAR MASTER OF COMMERCE (M. COM.) DEGREE PROGRAM

Level	Semester	Major Subject		RM	OJT, RP	Cum. Cr/Sem	Degree / Cum. Cr.
		Mandatory	Electives				
6.0	I	3 Courses – 4 Cr.	1 Course – 4 Cr.	1 Course – 4 Cr		20	PG Diploma with Major – 40 Cr.
	II	3 Courses – 4 Cr.	1 Course – 4 Cr.	–	OJT – 4 Cr.	20	
	Cum. Cr.	**24**	**8**	**4**	**4**	**40**	
Exit Option for Post Graduate Diploma after Three Year Degree (40 Credits)							
6.5	II	3 Courses – 4 Cr.	1 Course – 4 Cr		RP – 4 Cr.	20	Post Graduate Degree – 82 Cr.
	IV	3 Courses – 4 Cr	1 Course – 4 Cr.	--	RP – 6 Cr.	22	
	Cum. Cr.	**24**	**8**	**-**	**10**	**42**	
Total Cum. Cr.		**48**	**16**	**4**	**14**	**82**	

Abbreviations:

- RM Research Methodology
- OJT – On Job Training / Summer Internship Program
- RP – Research Project

POST GRADUATE PROGRAM IN SOCIOLOGY

RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

POST GRADUATE (CBCS) (NEP) SEMESTER SYLLABUS

2023-2024

POST GRADUATE PROGRAM IN SOCIOLOGY

Structure and Credit Distribution of PG Degree Programme (Two Years) w.e.f. 2023-24.

First Year: Semester I

Level	Course type		Course Code	Title of Course	Credit scheme	Examination and Assessment Scheme		Minimum Passing grade letter/ point (40%)	Total
						Internal Evaluation	End SEM Exam.		
6.0	Major	Mandatory	PGSO1M01	Classical Sociological Thinkers	4	20	80	B/6	100
			PGSO1M02	Perspective on Indian Society -I	4	20	80	B/6	100
			PGSO1M03	Constitution and Social Change in India	4	20	80	B/6	100
			PGSO1M04	Sociology of Religion - I	2		50	B/6	50
		Elective	PGSO1E05	G1P1: Family, Kinship and Marriage	4	20	80		100
			PGOS1E06	G2P1: Gender and Society.					
			PGSO1E07	G3P1: Sociology of Social Movement					
			PGSO1E08	G4P1: Sociology of Education					
	RM		PGSO1M09	Quantitative Research Methodology **OR** Qualitative Research Methodology	4	20	80	B/6	100
	Cumulative Credit/ Marks				**22**				**550**

Note: For **Elective** Department offers **4 Groups or Specialisations**. Student should select any group from these and follow the same till the end of program. There is no choice for selecting paper from other group in upcoming semesters.

RM: Research Methodology, RP: Research Project, CS: 40%

Dr. J R Bhange

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POST GRADUATE PROGRAM IN SOCIOLOGY
Structure and Credit Distribution of PG Degree Programme (Two Years) w.e.f. 2023-24.
First Year: Semester II

Level	Course type		Course Code	Title of Course	Credit scheme	Examination and Assessment Scheme		Minimum Passing grade letter/point (40%)	Total
						Internal Evaluation	End SEM Examination		
6.0	Major	Mandatory	PGSO2M01	Contemporary Sociological Theory	4	20	80	B/6	100
			PGSO2M02	Perspectives on Indian Society-II	4	20	80	B/6	100
			PGSO2M03	Sociology of Change and Development	4	20	80	B/6	100
			PGSO2M04	Sociology of Religion - II	2		50	B/6	50
		Elective	PGSO2E05	G1P2: Rural and Urban Transformation	4	40	60	B/6	100
			PGSO2E06	G2P2: Women In Indian Society					
			PGSO2E07	G3P2: Social Movement in India					
			PGSO2E08	G4P2: Education and Society in India					
	OJT/FP		PGSO2M09	Field project **FP**	4	100		B/6	100
	Cumulative Credit/ Marks				**22**				**550**
	Cumulative Credit for PG diploma (Sem. 1+2)				**44**				
	Exit option: PG Diploma (40 Credits) after three years UG Degree								

Note: For **Elective** Department offers **4 Groups or Specialisations**. Student should select any group from these and follow the same till the end of program. There is no choice for selecting paper from other group in upcoming semesters. **RM: Research Methodology** **OJT: On Job Training: Internship/Apprenticeship** **C5: 40 %**

Dr V R Bhange

POST GRADUATE PROGRAM IN SOCIOLOGY

Structure and Credit Distribution of PG Degree Programme (Two Years) w.e.f. 2023-24.

Second Year: Semester III

Level	Course type		Course Code	Title of Course	Credit scheme	Examination and Assessment Scheme		Minimum Passing grade letter / point (40%)	Total
						Internal Evaluation	End SEM Exam		
6.5	Major	Mandatory	PGSO3M01	Modern Sociological Theories	4	20	80	B/6	100
			PGSO3M02	Feminist Sociological Thinkers	4	20	80	B/6	100
			PGSO3M03	Globalisation and Society	4	20	80	B/6	100
			PGSO3M04	Social Problems in Contemporary India	2		50	B/6	50
		Elective	PGSO3E05	G1P3: Sociology of Social Stratification	4	40	60	B/6	100
			PGSO3E06	G2P3: Sociology of Social Exclusion					
			PGSO3EO7	G3P3: Media and Society					
			PGSO3E08	G3P3: Environment and Society					
	RP		PGSO3M09	Research Project	4	100		B/6	100
	Cumulative Credit/ Marks				66				550

Note: For **Elective** Department offers **4 Groups or Specialisations**. Student should select any group from these and follow the same till the end of program. There is no choice for selecting paper from other group in upcoming semesters.

RP: Research Project

C5: 40%

POST GRADUATE PROGRAM IN SOCIOLOGY

Structure and Credit Distribution of PG Degree Programme (Two Years) w.e.f. 2023-24.

Second Year: Semester IV

Level	Course type		Course Code	Title of Course	Credit scheme	Examination and Assessment Scheme		Minimum Passing grade letter / point (40%)	Total
						Internal Evaluation	End SEM Examination		
6.5	Major	Mandatory	PGSO4M01	Postmodern Social Theories	4	20	80	B/6	100
			PGSO4M02	Recent trends in Social Theories	4	20	80	B/6	100
			PGSO4M03	Economy and Society	4	20	80	B/6	100
		Elective	PGSO4E04	G1P4: Sociology of Marginalized Communities	4	20	80	B/6	100
			PGSO4E05	G2P4: Science, Technology and Society					
			PGSO4E06	G3P4: Culture and Symbolic Transformation					
			PGSO4E07	G4P4: State, Politics and Development					
	RP		PGSO4M08	Research Project	6	150		B/6	150
	Cumulative Credits/ Marks				22				550
	Cumulative Credit for 2-year PG degree				88				

2 Year - 4 Semester PG Degree (80 credits) after three-year UG degree

OR

1 Year- 2 Sem PG Degree (40 credits) after four year of UG degree

Note: For **Elective** Department offers **4 Groups or Specialisations**. Student should select any group from these and follow the same till the end of program. There is no choice for selecting paper from other group in upcoming semesters.

RP: Research Project, C5: 40%

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY

P.G. CBCS (NEP) Semester Pattern Syllabi of SOCIOLOGY

STRUCTURE OF THE CBCS (NEP) SEMESTER PATTERN P.G. PROGRAM

The P.G. CBCS semester pattern shall come into force from the academic year2023 - 2024 for the students seeking enrollment in semester I. While the students of semester III and semester IV shall go through the CBCS semester pattern examinations.

1. The CBCS (NEP) semester pattern P.G. PROGRAM shall give sufficient opportunity to the students of all departments for choice of subjects as shown in major electives.
2. The whole course shall be of full-time course of two years duration.
3. The semester I, II and III shall have four major mandatory papers (compulsory papers) and one core elective paper (optional papers) in four groups offering wider choice to the students to opt for any one group of them. The semester IV shall have three major mandatory papers (compulsory papers). There shall be again one core elective paper, which is in continuation of the group, which opt in first semester.
4. In semester I, students shall have a choice to choose any one of the course from RM (Research methodology) which he want to use in research projects of semester III & IV. RM is mandatory course.
5. In semester II, student himself shall engage in fieldwork and submit a fieldwork report to the institution/department. Based on hours engage in fieldwork and report submitted to institution/department, his/her credits will be evaluated. University will provide the direction time to time on the process of evaluation of fieldwork and other issues related to this course.
6. In semester III and IV, student shall avail a course RP (Research Project) which is mandatory and divided into two parts. The courses Research Project - I and Research Project - II, which shall opt by students, are the part of Semester III and Semester IV simultaneously. Student in the guidance of supervisor shall decide the topic of this course. The conditions of supervisor-ship and other issues will be decided by university time to

time.

7. 2100 marks, i.e. 88 credits in order to be awarded M.A. degree in Sociology by RTM Nagpur University.
8. The CBCS P.G. course shall be based on continuous internal evaluation of the students out of 20 marks in each paper (except 2 credits paper), along with the external evaluation based on a descriptive written examination of 80 marks by the university.

   Regarding 2 credits papers, University or Board of studies will declare the policy as per further notifications.

CODE OF EXAMINATION

Written Examination:

1. There shall be a written external examination of descriptive type in each paper at the end of every semester.
2. Each 4-credit paper shall be of 80 marks of external examination of 3 hours duration and 2-credit papers shall be of 50 marks of external examination of 2 hours duration.
3. The question paper shall contain 5 questions (four long questions and one short question) with an internal choice except for the short question. The short question shall be put like A, B, C and D at the question No. 5 i.e. the last question of the paper. The students shall have to answer all questions including all A, B, C and D of Q No.5.
4. Each question shall carry an equal value of 16 marks in 4-credit course and 10 marks in 2-credit course.

Nature of Internal Evaluation:

1. There shall be an internal evaluation of each student of 20 marks in each theory paper at the end of every semester in 4-credit course. It should be note that there is no internal evaluation in 2-credit courses.
2. Out of 20 internal marks in each theory paper, 10 marks shall be for Home Assignment and another 10 marks for daily attendance, viva-voce test and seminar presentation of the students based on the course content. The viva-

voce tests and seminar presentations shall be conducted by a committee consisting of the Head of the Department/Principal of the college/Director of the Institute or Centre running the P.G. Course and the teacher of the concerned subject.

3. The teacher of the concerned subject shall decide the task to be assigned to the students for home assignment, viva-voce test and seminar presentation. The students' evaluation shall be done on consensus among all the members of the committee conducting the viva-voce test and seminar presentation.

Passing Marks

1. The students shall be required to score a minimum of 40 marks in each paper out of 100 including internal marks in order to pass in the examination.
2. Scheme of Marking for Research Paper - I and II

A. Examination and Evaluation scheme for field Project)FP)

Sr.	Contents	hours	Marks Distribution
1	Orientation of Field Project	10 (2*5)	-
2	Field Work	96hours (16*6)	40
3	Field Diary	Related to FW	10
4	Report Writing	12 hours (2*6)	20
5	Presentation	2 hours	10
6	Internal Viva-voce	---	20

Internal Viva-voce conducted on the objectives of Field project with Power point Presentation. Its Field Diary and Field Report should be consider a basic document for viva-voce.

B. EXAMINATION SCHEME FOR RESEARCH PAPER – I : DISTRIBUTION OF 80 MARKS

*Research method adopt as per Research Method Paper (RM) avail in Semester I.

Sr. No.	Topic	Maximum Marks Allotted
1	Introduction (Theoretical Framework)	25
2	20 Research reviews	15
3	Research Gap	05
4	Formulation of Research Question	05
5	Formulation of objectives and tentative hypothesis	10 (5 marks each)
6	Research Method* - Justification of selection of sample & sample size & tools of data collection	15
7	Proper referencing and /or Bibliography (Use of APA Method)	05

Note: Internal Marks (max. 20) should be allotted according to his library work

C. EXAMINATION SCHEME FOR RESEARCH PAPER – I I : DISTRIBUTION OF 80 MARKS

* For analysis of data in quantitative methods SPSS and for qualitative method Atlas-ti is prescribing.

Sr. No.	Topic	Maximum Marks Allotted
1	Making of proper Questionnaire	10
2	Socio-economic Background of Respondents* (Chapter 1)	10
3	Chapters According to Objectives* (proper presentation with related referencing) (min. 3 chapters)	30 (10 per chapter)
4	Presentation of Data in Tables and Cross tables form	10
5	Presentation of Data in Graphical Form	10
6	Final Chapter i.e. Conclusion	05
7	Proper referencing and /or Bibliography (Use of APA Method)	05

Note: Internal Marks (max. 20) should be allotted according to his pilot study, field work, etc.

PROGRAM OUTCOMES FOR MA SOCIOLOGY PROGRAM

Targeted Graduated Attributes: Disciplinary Knowledge, Critical thinking, Problem solving, Analytical Reasoning, Communication Skill, Teamwork, Moral and Ethical Awareness

1. **P01** The student will be able to develop aptitude to manifest wide and extensive knowledge in the field of sociology.
2. **P02** Courses are designed in such a way that constitutional values will be imparted to students.
3. **P03** It develops the way to substantiate critical reading of literary text in order to conduct research in the field of sociology.
4. **P04** Students will be able to gain life skills as well as advanced skills necessary for professional advancement.
5. **P05** It also develops the ability of intensive research, investigation and critical analysis, usually in response to specific research question and hypothesis.
6. **P07** Courses in the program in sociology designed in such a way that the student must gain the knowledge of requirement of job market and skills required for job market in advancing societies.

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COURSE WISE COURSE-OUTCOME

SEMESTER FIRST

COURSE CODE	TITLE OF COURSE	COURSE OBJECTIVES
PGSO1M01	CLASSICAL SOCIOLOGICAL THINKERS	1. Students develop critical thinking and analytical skills. 2. To learn to analyze complex social phenomena, understand the underlying structures of society, and critically evaluate different perspectives on social issues. 3. To enable students to approach social problems and phenomena with a deeper understanding and the ability to analyze them from multiple angles, leading to informed decision-making and problem-solving in various personal, academic, and professional contexts.
PGSO1M02	PERSPECTIVES ON INDIAN SOCIETY - I	1. To develop cultural awareness and sensitivity towards diverse social perspectives and experiences in India. 2. students will gain insights into the complexities of Indian society, particularly with regards to tribes, caste, gender, family, and kinship. 3. enable students to understand and appreciate the diverse cultural practices, beliefs, and social structures that exist in India.
PGSO1M03	CONSTITUTION AND SOCIAL CHANGE IN INDIA	1. To develop students' constitutional literacy and understanding. 2. To critically analyze the constitutional provisions related to education, employment, health, social justice, individual rights, minority rights, and the rights of weaker sections. 3. Students will develop a deep appreciation for the constitutional framework that guides the social, economic, and political aspects of Indian society, equipping them to participate actively in democratic processes and advocate for social change.
PGSO1M04	SOCIOLOGY OF RELIGION - I	1. To develop a comprehensive understanding of the sociology of religion as a scientific discipline. 2. Explore the relationship between religion and morality, religious beliefs, and values, and gain insights into different ideologies such as theism, atheism, secularism, and fundamentalism.
PGSO1E05	G1P1 : FAMILY, KINSHIP AND MARRIAGE	1. To develop a comprehensive understanding of family, kinship, and marriage theories and concepts, including structural-functionalism, alliance theory, and cultural approaches. Examine constitutional laws related to inheritance, succession, and authority within families.

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		2. To analyze power dynamics, gender relations, and changing gender roles within families. Investigate the conditions of children, youth, and families, with a focus on the influence of gender on power dynamics. 3. Study the intersection of family, laws, and violence, including domestic violence, crimes against women, and honor killings within the context of marriage, family, and caste dynamics.
PGSO1E06	G2P1 : GENDER AND SOCIETY	1. To develop a comprehensive understanding of the social construction of gender, including the role of patriarchy and socialization in shaping gender norms and expectations. 2. Explore the dilemmas associated with gender, such as the tension between biology and gender, equality and difference, and the public and private spheres. 3. To examine different feminist theories, including liberal feminism, Marxist feminism, radical feminism, and black feminism.
PGSO1E07	G3P1 : SOCIOLOGY OF SOCIAL MOVEMENT	1. To develop a comprehensive understanding of social movements by exploring reform, revival, revolutionary, protest, and counter movements and to examine theories of social movements. 2. To analyze the relationship between social movements and social transformation. 3. Study the scenario of social movements in India, examining leadership, organizations, and the role of ideology. 4. Analyze different types of ideology associated with social movements and their impact on guiding movements and creating social unrest.
PGSO1E08	G4P1 : SOCIOLOGY OF EDUCATION	1. To examine the influence of gender, caste, and class on education and recognize the significance of studying the sociology of education in understanding social dynamics. 2. To analyze traditional perspectives of education. 3. To understand the key concepts and theories proposed by these sociologists in relation to education and to explore new theoretical perspectives in the sociology of education.
PGSO1M09	RM1 : QUANTITATIVE METHOD IN SOCIAL RESEARCH OR RM2 : QUALITATIVE METHOD IN SOCIAL RESEARCH	1. To develop a comprehensive understanding of social research, including its meaning, nature, and ethical considerations. 2. Explore the formulation of research problems, research design, sampling techniques, and data collection methods. 3. Understand the fundamentals of quantitative and qualitative research approaches. 4. To gain practical skills in data analysis and interpretation for both quantitative and qualitative research.

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SEMESTER SECOND

COURSE CODE	TITLE OF COURSE	COURSE OBJECTIVES
PGSOZM01	CONTEMPORARY SOCIOLOGICAL THEORY	1. To gain a comprehensive understanding of contemporary sociological theories by exploring the works of influential theorists. 2. To examine key sociological perspectives, including structuralism, functionalism, conflict theory, and symbolic interactionism. 3. Analyze the anthropological perspectives within structuralism, the concept of analytical functionalism within functionalism, the role of conflicts in social dynamics within conflict theory.
PGSOZM02	PERSPECTIVES ON INDIAN SOCIETY - II	1. studying perspectives on social change and development, students can develop a deep understanding of the factors that shape Indian society. 2. To analyze and navigate the complexities of social, economic, and political transformations in their personal and professional lives. 3. Develop a critical understanding of power dynamics and social movements.
PGSOZM03	SOCIOLOGY OF CHANGE AND DEVLOPMENT	1. To Develop a comprehensive understanding of social change and its dynamics. 2. To critically analyse and interpret social change processes in contemporary societies, including India. 3. Explore different approaches to development and their implications.
PGSOZM04	SOCIOLOGY OF RELIGION - II	1. To Develop a critical understanding of 2. To explore the place of religion in rational dialogue, its function in society, its social construction, and its manifestation as a social practice. 3. to critically analyze the complexities of religion in contemporary social contexts and develop a nuanced perspective on its significance.
PGSOZE05	G1P2 : RURAL AND URBAN TRANSFORMATION	1. To Develop a comprehensive understanding of rural community changes. 2. To explore the ruralization of tribes, migration patterns, and mutual adaptations. 3. to analyze the complexities of rural communities, including caste-tribal settlements and their implications for social dynamics.
PGSOZE06	G2P2 : WOMEN IN INDIAN SOCIETY	1. To Develop a comprehensive understanding of the changing profile of women in India 2. examine the demographic profile, gender gaps, and the intersection of gender with caste, class, and religion.

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		3. to critically analyze the social, cultural, and structural factors that shape women's experiences in Indian society. 4. to Examine the dynamics of patriarchy and women's experiences in India
PGSO2E07	G3P2 : SOCIAL MOVEMENT IN INDIA	1. To Develop a comprehensive understanding of social movements in India. 2. To explore the interplay between caste, class, and social movements, understanding the diverse factors that mobilize individuals and groups for social change. 3. to critically analyze the context, drivers, and outcomes of social movements in India.
PGSO2E08	G4P2 : EDUCATION AND SOCIETY IN INDIA	1. To Develop a comprehensive understanding of the socio-historical context of education in India. 2. To explore the significance of education in shaping social, cultural, and economic aspects of Indian society. 3. to critically analyze the influences and legacies of different historical periods on the present education system.
PGSO2M09	FIELD PROJECT	1. To Develop practical research skills. 2. To learn research design, data collection techniques, and data analysis methods relevant to their specific field of study. 3. To practical training enhances students' research skills, critical thinking abilities, and problem-solving capacities, which are valuable in various professional contexts.

SEMESTER THREE

COURSE CODE	TITLE OF COURSE	COURSE OBJECTIVES
PGSO3M01	MODERN SOCIOLOGICAL THEORY	1. To Develop a comprehensive understanding of contemporary sociological theories. 2. To explore concepts such as agency and structure, culture and agency, signifier and deconstructionism, knowledge and power, critical social theories, and phenomenological and ethnomethodological perspectives. 3. Enhance critical thinking and analytical skills.
PGSO3M02	FEMINIST SOCIOLOGICAL THINKERS	1. To Develop a comprehensive understanding of feminist sociological theories. 2. To explore existentialist perspectives on gender, critiques of traditional gender roles, politics of sexuality, reconstructions of historical materialism, psychoanalysis and feminism, intersectionality, and deconstructions of sex and gender. 3. Foster critical thinking and awareness of gender issues.

PGSO3M03	GLOBALIZATION AND SOCIETY	1. To Develop a critical understanding of globalization. 2. To explore different perspectives on globalization, including Westernization, Easternization, Americanization, and Anti-Americanization. 3. critically analyze the role of the nation-state, civil society, cultural hybridization, and cultural convergence in shaping the global structure.
PGSO3M04	SOCIAL PROBLEMS IN CONTEMPORARY INDIA	1. To Develop a comprehensive understanding of social problems in India. 2. To explore the issues of casteism, atrocities, unequal distribution of power, gender inequality, and its socio-economic and political consequences. 3. To analyze the challenges posed by population growth, urbanization, and their impact on health, habitat, natural resources, and socio-economic conditions.
PGSO3E05	G1P3 : SOCIOLOGY OF SOCIAL STRATIFICATION	1. To Develop a comprehensive understanding of social stratification. 2. To explore the distinction between social inequality and biological/natural inequality, recognizing that social stratification is a product of social processes rather than inherent biological differences. 3. to critically analyze the mechanisms and consequences of social stratification in different societies.
PGSO3E06	G2P3 : SOCIOLOGY OF SOCIAL EXCLUSION	1. To Develop a comprehensive understanding of social exclusion. 2. to critically analyze the mechanisms and consequences of social exclusion in diverse contexts. 3. Analyze social categories and social exclusion: Students engage with various social categories and their relationship with social exclusion.
PGSO3E07	G3P3 : MEDIA AND SOCIETY	1. To Develop a comprehensive understanding of media in society. 2. To explore theories of mass media, including the pluralist, Marxist, and neo-Marxist perspectives, which provide different frameworks 3. To Analyze the role and influences of media.
PGSO3E08	G4P3 : ENVIRONMENT AND SOCIETY	1. To Develop a comprehensive understanding of the environment and its impact on society. 2. enables students to critically analyze the interdependencies between society and the environment. 3. Analyze the social dimensions of environmental issues.
PGSO3M09	RESEARCH PROJECT	1. To equip students with the necessary skills and knowledge to effectively write a comprehensive research report. 2. writing a research report, students will

17/7/23

		develop essential skills in research methodology, critical analysis of literature

SEMESTER FOUR

COURSE CODE	TITLE OF COURSE	COURSE OBJECTIVES
PGSO4M01	POSTMODERN SOCIAL THEORIES	1. To Explore and analyze postmodern perspectives on society. 2. Critically evaluate the implications of postmodern social theories
PGSO4M02	RECENT TRENDS IN SOCIAL THEORIES	1. To Explore and critically analyze recent trends in social theories. 2. Examine the impact of information technology and digital society.
PGSO4M03	ECONOMY AND SOCIETY	1. To develop a nuanced understanding of the interconnections between economic systems, social structures, and power dynamics. 2. to critically analyze key economic concepts, debates, and emerging trends, enabling them to navigate and contribute to socio-economic environments.
PGSO4E04	G1P4 : SOCIOLOGY OF MARGINALIZED COMMUNITIES	1. To Understand the concept of marginalized communities and the bases of marginalization. 2. To explore the socio-economic and political factors that contribute to marginalization, including discrimination, deprivation, exploitation, segregation, and poverty. 3. Examine marginalized communities in India and explore means of eradicating marginality.
PGSO4E05	G2P4 : SCIENCE, TECHNOLOGY AND SOCIETY	1. To Explore the historical development of science and technology. 2. To analyze changing notions of time and space, including the shift from physical to virtual spaces. 3. Examine the social implications of science and technology.
PGSO4E06	G3P4 : CULTURE AND SYMBOLIC TRANSFORMATION	1. gain a critical awareness of the complexities of cultural dynamics and their implications for various aspects of society. 2. to develop skills in cultural analysis, allowing them to navigate and contribute to the ever-evolving cultural landscape, understand the interplay of cultural forces with religion, politics, and societal trends.
PGSO4E07	G4P4 : STATE, POLITICS AND DEVELOPMENT	1. To develop interest politics, understanding the concepts of interest, ideology, and political fractions. 2. to provide a solid foundation in state, politics, and development, enabling them to comprehend the complexities of political systems, analyze social issues, and contribute to societal progress and transformation.
PGSO4M08	RESEARCH PROJECT	1. To equip students with the necessary skills

		and knowledge to effectively write a comprehensive research report. 2. writing a research report, students will develop essential skills in research methodology, critical analysis of literature, academic writing, and proper citation. These skills are highly valuable in academic and professional settings, including research careers, policy-making, and further studies at the graduate level.

Content

SEMESTER FIRST

	COURSE CODE	TITLE OF COURSE	CREDIT
MANDATORY	PGSO1M01	CLASSICAL SOCIOLOGICAL THINKERS	4
	PGSO1M02	PERSPECTIVES ON INDIAN SOCIETY - I	4
	PGSO1M03	CONSTITUTION AND SOCIAL CHANGE IN INDIA	4
	PGSO1M04	SOCIOLOGY OF RELIGION - I	2
ELECTIVE (select any GROUP which will Continue in next semesters)	PGSO1E05	G1P1 : FAMILY, KINSHIP AND MARRIAGE	4
	PGSO1E06	G2P1 : GENDER AND SOCIETY	
	PGSO1E07	G3P1 : SOCIOLOGY OF SOCIAL MOVEMENT	
	PGSO1E08	G4P1 : SOCIOLOGY OF EDUCATION	
RM	PGSO1M09	RM1 : QUANTITATIVE METHOD IN SOCIAL RESEARCH OR RM2 : QUALITATIVE METHOD IN SOCIAL RESEARCH	4

SEMESTER SECOND

	COURSE CODE	TITLE OF COURSE	CREDIT
MANDATORY	PGSO2M01	CONTEMPORARY SOCIOLOGICAL THEORY	4
	PGSO2M02	PERSPECTIVES ON INDIAN SOCIETY - II	4
	PGSO2M03	SOCIOLOGY OF CHANGE AND DEVLOPMENT	4
	PGSO2M04	SOCIOLOGY OF RELIGION - II	2
ELECTIVE (Continue the group as per previous semester)	PGSO2E05	G1P2 : RURAL AND URBAN TRANSFORMATION	4
	PGSO2E06	G2P2 : WOMEN IN INDIAN SOCIETY	
	PGSO2E07	G3P2 : SOCIAL MOVEMENT IN INDIA	
	PGSO2E08	G4P2 : EDUCATION AND SOCIETY IN INDIA	
FP	PGSO2M09	FIELD PROJECT	4

SEMESTER THREE

	COURSE CODE	TITLE OF COURSE	CREDIT
MANDATORY	PGSO3M01	MODERN SOCIOLOGICAL THEORY	4
	PGSO3M02	FEMINIST SOCIOLOGICAL THINKERS	4
	PGSO3M03	GLOBALIZATION AND SOCIETY	4
	PGSO3M04	SOCIAL PROBLEMS IN CONTEMPORARY INDIA	2
ELECTIVE (Continue the group as per previous semesters)	PGSO3E05	G1P3 : SOCIOLOGY OF SOCIAL STRATIFICATION	4
	PGSO3E06	G2P3 : SOCIOLOGY OF SOCIAL EXCLUSION	
	PGSO3E07	G3P3 : MEDIA AND SOCIETY	
	PGSO3E08	G4P3 : ENVIRONMENT AND SOCIETY	
RP	PGSO3M09	RESEARCH PROJECT	4

SEMESTER FOUR

	COURSE CODE	TITLE OF COURSE	CREDIT
MANDATORY	PGSO4M01	POSTMODERN SOCIAL THEORIES	4
	PGSO4M02	RECENT TRENDS IN SOCIAL THEORIES	4
	PGSO4M03	ECONOMY AND SOCIETY	4
ELECTIVE (Continue the group as per previous semesters)	PGSO4E04	G1P4 : SOCIOLOGY OF MARGINALIZED COMMUNITIES	4
	PGSO4E05	G2P4 : SCIENCE, TECHNOLOGY AND SOCIETY	
	PGSO4E06	G3P4 : CULTURE AND SYMBOLIC TRANSFORMATION	
	PGSO4E07	G4P4 : STATE, POLITICS AND DEVELOPMENT	
RP	PGSO4M08	RESEARCH PROJECT	6

SEMESTER: I

MANDATORY PAPERS

PAPER CODE : PGSO1M01

CLASSICAL SOCIOLOGICAL THINKING

Unit 1. Karl Marx:

A. Class Formation and Class Struggle

B. Dialectical Materialism and the Theory of Social Change

C. Alienation, Surplus Value and Exploitation

Unit 2. Max Weber:

A. Social Action: Theory and Types of Social action

B. Protestant Ethic in the Emergence of Modern Capitalism

C. Ideal Types of Authorities and Bureaucracy

Unit 3. Emile Durkheim:

A. Social Facts: Its Characteristics and importance

B. Division of Labour: Its Causes and Functions, Mechanical and Organic Solidarity

C. Religion: Sacred and Profane elements in the Context of Religion

Unit 4. Sigmund Freud

A. Theory of Personality and dream

B. Theory of Religion

C. Psychosexual development, Feminity

Suggested Readings:

1. George Ritzer, 1996, Sociological Theory, The McGRAW-HILL International Editions.
2. Parsons Talcott, The Structure of Social Action, Vol. I & II, McGraw Hill, New York.
3. Nisbet, 1966, The Sociological Tradition, Heinmann Educational Books Ltd, London.
4. Zetlin Irving, 1981, Ideology and the Development of SociologicalTheory, Prentice Hall.
5. Dahrendorf Ralph, 1959, Class and Class Conflict in Industrial Society.
6. Bendiz Rinehard, 1960, Max Weber, An Intellectual Portrait.
7. Popper Karl, 1945, Open Society and its Enemies, Routledge, London.
8. Aron Raymond, Main Currents in Sociological Thought, Vol. I & II, Penguin.
9. Coser L.A., 1977, Masters of Sociological Thought, New York.
10. Giddens Anthony, 1997, Capitalism and Modern Social Theory.
11. Writings of Marx, Durkheim and Weber, CambridgeUniversityPress.
12. R.N. Mukherjee and Arunansu Ghoshal, Social Thought, Vivek Prakashan, Delhi.
13. Francis Abraham and John Henry Morgan, Sociological Thought.
14. Michael Haralambos and Martin Holborn, 2000, Sociology: Themes and Perspectives, Harper Collins, London.
15. H.E. Barnes, Introduction to Sociology.
16. N.S. Vaidya, Samajik Vicharvant.

PAPER CODE : PGSO1M02

PERSPECTIVES ON INDIAN SOCIETY - I

Unit 1. Perspectives on Tribe

A. **G.S. Ghurye** : Tribes as Backward Hindus and Their Future

B. **Virginius Xaxa** : Tribes as Indigenous People of India

Unit 2. Perspectives on Caste

A. **B.R. Ambedkar** : Caste as a Socio-Cultural, Economic and Political System. Ways of Annihilation of Caste

B. **Gopal Guru** : Humiliation in Caste; Experiencing Caste and Everyday Social

Unit 3.Perspectives on Gender

A. **Kamala Bhasin** : Macsulanity, Patriarchy and Gender

B. **Uma Chakravatri** : Gendering Caste

Unit 4 Family and Kinship

A. **Irawati Karve**: Kinship Organization in India.

B. **Patricia Uberoi**: Family, Kinship and Marriage.

Suggested Readings

1. Surinder Jodhka, (2013) Interrogating India's Modernity: Democracy, Identity, and Citizenship, Oxford University Press.
2. Pathak Avijit. 1998, Indian Modernity, Aakar Books.
3. Pathak Avijit. 2006, Modernity Globalization and Identity, Aakar Books.
4. Hamilton Lawrence. 20200 How to read Amartya Sen, Penguin Random House
5. Banerjee Abhijit; Duflo Esther. 2011, Poor Economics: Rethinking Poverty & the Ways to End it, Penguin Books.
6. Banerjee Abhijit; Duflo Esther. 2019, Good Economics for Hard Times: Better Answers to Our Biggest Problems. Juggernaut.
7. Rege Sharmila. 2006, Writing Caste/Writing Gender, Zubaan Publication.
8. Rege Sharmila. 2018. Gendering Caste: Through A Feminist Lens, Sage.
9. Rege Sharmila. 2003, Sociology of Gender: The Challenge of Feminist Sociological Thought, Sage.
10. Uberoi Patricia. 1997, Family Kinship and Marriage in India, OIP.
11. Bhasin Kamla. 2000, Understanding Gender, Kali for women.
12. Bhasin Kamla. 2004, Exploring Masculinity, Women Unlimited.
13. Gopal Guru, Sundar Sarukkai. 2019 Experience, Caste, and the Everyday Social, Oxford University Press.
14. Gopal Guru, Sundar Sarukkai. 2018, The Cracked Mirror: An Indian Debate on Experience and Theory, Oxford University Press.

15. Xaxa Virginius. 2008, State, Society and Tribes: Issues in Post-Colonial India, Pearson.
16. Xaxa Virginius. 2012, Social Exclusion and Adverse Inclusion: Development and Deprivation of Adivasis in India (Ed.), OUP.
17. Xaxa Virginius & Jagannath Ambagudia. 2020, Handbook of Tribal Politics in India. Sage.
18. DeSouza, P.R. (ed), 2000, Contemporary India-Transitions, New Delhi, Sage.
19. Dhanagare, D.N. 1993, Themes and Perspectives in Indian Sociology, Jaipur, Rawat.
20. Dube, S.C. 1973, Social Sciences in a Changing Society, LucknowUniversity Press.
21. Dube, S.C. 1967, The IndianVillage, London, Routledge, 1955.
22. Karve, Irwati. 1961, Hindu Society: An Interpretation, Poona, DecanCollege.
23. Momin, A.R. 1996, The Legacy of G.S. Ghurye: A Centennial Festschrift, Popular Prakashan, Bombay.
24. Mukherjee, D.P. 1958, Diversities, People"s Publishing House, Delhi.
25. Singh, Y. 1986, Indian Sociology: Social Conditioning and Emerging Concerns, Delhi Vistaar.
26. Singh, Y. 1973, Modernization of Indian Tradition, Delhi, Thomson Press.
27. Srinivas, M.N. 1960, India"s Villages, Asia Publishing House, Bombay.
28. Tylor, Stephen: India;An Anthropological Perspective.
29. Guha, Ranjit (ed), 1982, Subaltern Studies: Writings on South Asian History and Society, Oxford.
30. Desai, A.R. 1948, Social Background of Indian Nationalism, Popular, Bombay.
31. Ambedkar, B.R. Speeches and Letters, Bombay.
32. Sinha, Surajit. 1980, Tribes and Indian Civilization, In Manin India.
33. Bose, Nirmal Kumar, Problems of Indian Nationalism, Calcutta.
34. Singhi, N.K.1996, Theory and Ideology in Indian Sociology, Rawat, Jaipur.

PAPER CODE : PGSO1M03

CONSTITUTION AND SOCIAL CHANGE IN INDIA

1. **Understand the Objectives of Indian Constitution**
   A. Welfare state and Socialism : Education, Employment, Health and Social Justice
   B. Secularism : Rights of Individual, Minorities and Weaker Section, Development Scientific Perspective (Directive Principles)
   C. Constitution as Social Document : Constitutional Values: Values in Preamble, Fundamental Duties and Directive principles
2. **Constitution and Transformation in India**
   A. Social Transformation : Capitals & Changes in Caste, Gender and Women's Rights; Marital Laws, Education Rights
   B. Economic Transformation : Changes in Occupational Structure, Labour laws and Property Rights
   C. Political Transformation: Democratic-Electoral Politics, 73rd Amendment: Grassroots' Democracy, Emergence of caste Politics
3. **Constitutional Development and Indian Society**
   A. Social Structure and Constitution: Social Structure as an inhibiter of Constitutional development with reference to Caste, Religion and Gender
   B. Cultural and Constitution : Emergence of Multiculturalism and Secular Culture
   C. Class and Constitution : Industrialization, Migration and Urbanization
4. **Modernization, Globalization and Constitution**
   A. Values of Modernization in Indian Constitution
   B. Globalization and Indian Constitution : Critical Analysis - Rise in Inequality and degradation of Welfare State
   C. Media and Constitution: Right to Expression, Monopolization of Media and Control of Political opinions.

Reference Books

1. Indian Constitution
2. Oxford Handbook of Indian Constitution, OUP
3. Indian Social Structure and Change, K.L. Sharma, Rawat

4. Constitutional Debates Debates
5. Introduction to Indian Constitution : D.D. Basu,
6. Liberlism, Constitutionalism and Democracy, Russel Hardin, OUP
7. Evolution of a Revolution, Li-ann Thio and Kevin YL Tan, Routledge
8. The Constitution of Society, Anthony Giddens, Polity Press, Cambridge
9. A Constitutional Hhistory of India, A.B. keith, , Methuen & Co. Ltd. London
10. Working a Democratic Constitution: The Indian Experience, Granville Austin , OUP
11. Discourse and Social Change, Norman Fairclough, Polity Press, Cambridge
12. Dynamics of Caste and Law: Dalit Oppressions and Constitutions, Cambridge
13. Deterring Democracy, Noam Chomsky, RHUK
14. Politics and Ethics of Indian Constitution, Rajiv Bhargav, OUP
15. Democracy in India, N.G Jayal, OUP
16. Makers of Modern India, R. Gunah, penguin
17. Law and Social Transformation in India, Oliever Mendelsohn, OUP

PAPER CODE : PGSO1M04

SOCIOLOGY OF RELIGION - I

Unit 1. Introduction:

A. Sociology of religion: Religion as a science

B. Religion and morality, religious beliefs and values

C. Theism, atheism, secularism and fundamentalism

Unit 2. Sociological Perspectives on Religion:

A. Durkheim: Religion for integration

B. Weber: Religion, rationality and development

C. Karl Marx: Religion as illusion

Suggested Readings:

1. Weber, M. The Sociology of Religion, Boston, Mass: Beacon Press, 1963.
2. Eliade, H. The Sacred and the Profane: The Nature of Religion, New York: Harcourt, Brace and World, 1959.
3. Durkheim, E. The Elementary Forms of Religious Life, London: Allen and Unwin, 1915.
4. Fischer, M.N.J. Iran: From Religious Dispute to Revolution, Cambridge, Mass: Harvard University Press, 1980.
5. Baird, Robert D, (ed.) 1995 (3rd edition) Religion in Modern India, Delhi, Manohar.
6. Jones, Kenneth W., 1989, Socio-Religious Reform Movements in British India, The New Cambridge History of India III - I),Hyderabad, Orient Longman.
7. Madan T.N. (ed.) 1992, (enlarged edition), Religion in India, New Delhi, Oxford Press.
8. Mazumdar H.T., 1986, India"s Religious Heritage, New Delhi, Allied Publishers.
9. Roberts, Keith A., 1984, Religion in Sociological Perspective, New York, Dorsey Press.
10. Shakir Moin (ed.) 1989, Religion, State and Politics in India, Delhi,Ajanta Publications.
11. Turner Bryan. S., 1991 (2nd edition) Religion and Social Theory, London, Sage Publications.
12. Robinson, Rowena, 2004, Sociology of Religion in India, Sage, India.

ELECTIVE COURSES

Important Note : Opt any group as an elective course throughout whole PG program. Once you opt a group, cannot be change in any further semesters. In following coding, 'G' stands for group (i.e. G1 means group 1) and 'P' stands for paper/course (i.e. P1 means course/paper 1).

PAPER CODE : PGSO1E05

G1P1 : FAMILY, KINSHIP AND MARRIAGE

Unit 1. Theory and some concepts.

A. Theoretical Approaches: Structural-Functionalist, Alliance and Cultural

B. Constitutional laws of inheritance, succession and authority

Unit 2. Power and Gender dynamics

A. Condition of Child, youth and family

B. Gender relations and power dynamics

C. Gender and gender role in transition, sexuality in India and reproduction-controlling fertility, zero child and delayed parenting.

Unit 3. Change in marriage Family and support System

A. Changing Marriage practices in contemporary society and emerging patterns of marriage.

B. Emergent forms of family - Single parent family, Consensual Unions.

C. Changing care and support system at the age of globalisation and emerging problems.

Unit 4. Laws, Family and violence

A. Family Laws- Hindu and Muslim.

B. Domestic violence and Crime against women -Causes and Consequences

C. Honour killing - causes and pattern maintenance (marriage, family and caste).

Suggested Readings:

Schwartz Marry Ann & Scott BarBara, Marriage and Families: Diversity and Change, 3rd ed., Prentice Hall, New Jersey, 1999.

Macionis & Ken Plummer, *Sociology: Global Introduction*, 5th Ed. Pearson

Haralambos M., *Sociology: Themes and Perspective*, 8th Ed., Harper Collins Publishers Limited, 2013.

Giddens A. & Sutton P. W., *Sociology*, 7th ed., Wiley, 2013.

Patel Tulsi, ed., *The Family in India: Structure and Practice*, Sage India, 2005.

Imtiaz Ahmad, ed., *Family, Kinship and Marriage among Muslims in India*, Manohar Publishers & Distributors, 2020.
Breman Jan, *Beyond Patronage and Exploitation*, Oxford India Paperback, 1993.
Uberoi Patriia, ed., *Family, Kinship and Marriage in India*, Oxford in India Reading, 1993.
Ahuja Ram, *Social Problems in India*, 5th ed., Rawat Publication.
Veena Das, ed., Sociology and Social Anthropology, Vol. 1 & 2, Oxford, India, 2003.

PAPER CODE : PGSO1E06

G2P1 : GENDER AND SOCIETY

Unit 1. Social Construction of Gender:

A. Socialization and gender construction, patriarchy and gender construction

B. Dilemmas: Gender vs. biology, equality vs. difference, private vs. public

Unit 2. Feminist Theories:

A. Liberal Feminism, Marxist Feminism

B. Radical Feminism, Black Feminism

Unit 3. Gender inequality in society:

A. Unequal distribution of power and authorities

B. Patriarchal concept of labor and sexual division of labor,

C. Political participation and male dominance

Unit 4. Strategies to Overcome Gender Inequality:

A. Contemporary women's movement

B. Women's participation in politics and decision making

C. Women empowerment: Equal opportunity and development

Suggested Readings:

1. Altekar, A.S., 1983, The Position of Women in Hindu Civilization, Delhi, Motilal Banarasidas, Second Edition, Fifth Reprint.
2. Chodrow, Nancy, 1978, The Reproduction of Mothering, Berkely University of California Press.
3. Desai Neera and M Krishnaraj, 1978, Women and Society in India, Delhi, Ajanta.
4. Dube Leela et al (eds.) 1986, Visibility and Power: Essays on Women in Society and Development, New Delhi, OUP.
5. Forbes G., 1998, Women in Modern India, New Delhi, Cambridge University Press.
6. Maccoby, Eleaner and Carol Jackin, 1975, The Psychology of Sex Differences, Stanford, ,Stanford University Press.
7. Mc Cormack, C and M. Strathern (ed.) 1980, Nature, Culture and Gender, Cambridge, Cambridge University Press.
8. Kumkum Roy (ed.) 2005 Women in early Indian Society, Manohar Publishers and Distributors, New Delhi.
9. Myers, Kristen Anderson et al, (eds.) 1998, Feminist Foundations: Towards Transforming Sociology,New Delhi, Sage.
10. Oakely, Ann., 1972, Sex, Gender and Society, New York, Harper and Row.
11. Sharma, Ursula, 1983, Women, Work and Property in North-West India, London, Tavistock.
12. Shulamitz, Reinharz and Lynn Davidman, 1991, Feminist Research Methods, New York, OxfordUniversity Press.
13. Srinivas, M.N., Caste Its Modern Avatar, New Delhi, Penguin (Leela Dube's Article on Caste and Women)

14. Vaid, S and K Sangari, 1989, Recasting Women Essays in Colonial History, New Delhi.
15. Agarwal, B, 1994, A Field of One"s Own Gender and Land Rights in South Asia, Cambridge University Press.
16. Channa Karuna, 1988, Socialization, Women and Education: Explorations in GenderIdentity, New Delhi, Orient Longman.
17. Agarwal, B, 1994, A Field of One"s Own Gender and Land Rights in South Asia,Cambridge University Press.
18. Channa Karuna, 1988, Socialization, Women and Education: Explorations in GenderIdentity, New Delhi, Orient Longman.
19. Dube Leela, 1997, Women and Kinship: Comparative Perspectives on Gender in South and South-East Asia, Tokyo, United Nations University Press.
20. Gandhi, N and N. Shah, 1992, The Issues at Stake: Theory and Practice in the Contemporary Women"s Movement in India, New Delhi.
21. Ghadially, Rehana, (ed.) 1988, Women in Indian Society, New Delhi, Sage. Jaywardene, Kuman, 1991, Feminism and Nationalism in the Third World, New Delhi.
22. Miss Maria, 1980, Indian Women and Patriarchy: Conflicts and Dilemmas of Students and Working Women, New Delhi, Concept.
23. Omvedt Gail, 1975, Caste, Class and Wome"s Liberation in India, Bulletin of Concerned Asian Scholars.
24. Pardeshi, Pratima, 1988, Dr. Ambedkar and the Question of Women"s Liberation in India,Pune, WSC, University of Pune

PAPER CODE : PGSO1E07

G3P1 : SOCIOLOGY OF SOCIAL MOVEMENT

Unit 1. Understanding Social Movements:

A. Defining Features and Types of Social Movements, viz. Reform, Revival, Revolutionary, Protest, Counter Movements

B. Theories of Social Movement : Relative deprivation theory, structural strain theory, resource mobilization theory and political process theory

Unit 2. Social Movements and Social Transformation:

A. Bases of Social Movements: Caste, Class, Gender, Religion and Ethnicity

B. Issues in Social Movement: social structure and social movement, identity, culture and social movement, socio-economic and political interests and social movement

Unit 3. Scenario of Social Movements in India:

A. Leadership and organizations in social movements

B. Ideology in social movements: Types of ideology and social movements, ideology guiding movement and creating unrest

Unit 4. Social Movements in the Contemporary Times:

A. Media and social movement, public opinion social movement, democracy and social movement

B. Diffusion, absorption, and fragmentation of social movement

C. Counter movements and social transformation

Suggested Readings:

1. Banks, J.A., 1972, The Sociology of Social Movements, London, Macmillan.
2. Desai, A.R., (ed.) 1979, Peasant Struggles in India, Bombay, OxfordUniversity Press.
3. Dhanagare D.N., 1983, Peasant Movements in India 1920-1950, Delhi, OUP.
4. Gore M.S., 1993, The Social Context of an Ideology: Ambedkar's Political and Social Thoughts, New Delhi, Sage.
5. Oommen T.K., 1990, Protest and Change: Studies in Social movements, Delhi, Sage.
6. Rao M.S.A., 1979, Social Movements in India, New Delhi, Manohar.
7. Singh K.S., 1982, Tribal Movements in India, New Delhi, Manohar.
8. Selliot Eleanor, 1995, From Untouchable to Dalit: Essays on the Ambedkar Movement, New delhi, Manohar.
9. Gouldner A.W., 1950, (ed.) Studies in Leadership, New York, Harper and Brothers.
10. Oommen T.K., 1972, Charishma, Stability and Change: An Analysis of Bhoodan Gramdan Movement, New Delhi, Thomas Press.
11. Shah Ghanshyam, 1990, Social movements in India: A Review of the Literature, Delhi, Sage.
12. Shah Nandita, 1992, The Issues at Stake: Theory and Practice in the Contemporary Women's Movements in India.
13. Shiva Vandana, 1991, Ecology and the Politics Survival, New Delhi, Sage.

PAPER CODE : PGSO3E08

G4P1 : SOCIOLOGY OF EDUCATION

Unit 1. Understanding the Importance of Sociology of Education:

A. Definition, meaning and scope of sociology of education

B. Education: gender, caste and class

C. Significance of sociology of education

Unit 2. Traditional Perspectives of Education:

A. Functionalist perspectives: Emile Durkheim and Talcott Parsons

B. Conflict perspectives: Bowles & Gintis, and Paul Willis

Unit 3. Sociology of Education and New Theoretical Perspectives:

A. Social democratic perspective

B. Postmodern perspective: Robin Usher and Richard Edwards

C. Feminist Perspective

Unit 4. Education and Society:

A. Education: socialization, social identities

B. Education, social mobility, social change and development

C. Education: market and employment

Suggested Readings:

1. Haralambos, Michael, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Fifth Edition, Collins, London.
2. Acker, S, 1994, Gendered Education: Sociological Reflections on Women, Buckingham: Open University Press.
3. Banks, Olive, 1971, Sociology of Education, (2nd Ed.), London: Batsford.
4. Banks, James A. and Lynch, James (eds.) 1986, Multicultural Education in Western Societies, London: Holt Saunders.
5. Blackledge, D. and Hunt, B., 1985, Sociological Interpretations of Education, London: Crom Helm.
6. Brint, Steven, 1998, Schools and Societies, Thousand Oaks, Calif: Pine Forge Press, A Division of Sage.
7. Uttam B. Bhoite, 2009, Higher Education in India: A System on the Verge of Chaos, Sociological Bulletin, Vol.58, No.2, May-August.
8. Channa, Karuna, 1988, Socialization, Education and Women: Explorations in Gender Identity, New Delhi: Orient Longman.
9. Chanana, Karuna, 1979, „Towards a Study of Education and Social Change". In Economic and Political Weekly, 27, 14 (4): 157-64.
10. B.K. Swain, 1998, Changing Occupational Structure in Vidarbha, India, Himalaya Publishing House, Mumbai.
11. Chitnis, Suma and P.G. Albach, 1993, Higher Education Reform in India, Experience and

Perspectives, New Delhi: Sage.
12. Craft, Maurice, (e.d), 1970, Family, Class and Education: A Reader, London: Longman.
13. Dreze, Jean and Amartya Sen, 1995, Indian Economic Development and Social Opportunity, Oxford: OxfordUniversity Press.
14. Gandhi, M.K., 1962, Problems of Education< Ahmedabad: Navjeevan Prakashan.
15. Gore, M.S. et.al. (ed.), 1975, Papers on the Sociology of Education in India, New Delhi, NCERT.
16. Halsey, A.H., Hugh Lander, Phillips Brown and Amy S. Wells, 1997, Education, Culture, Economy and Society, Oxford, OxfordUniversity Press.
17. Jejeebhoy, Shireen, 1995, Women's Education, Autonomy and Reproductive Behaviour, Oxford: Clarendon Press.
18. Meighan, Ronald and Iram Siraj- Blatchford, 1997, Sociology of Educating, London: Cassell, Third Edition.
19. Robinson, P., 1987, Perspectives in the Sociology of Education: An Introduction, London: Routledge and Kegan Paul.
20. Sen, Amartya, 1992, Inequality re-examined, Delhi: Oxford University Press.
21. Shatrugan, M., 1988, Privatising Higher Education, EPW. Pp. 2624.
22. Ahmad Karuna, 1984, Social Context of Women's Education 1921-81, New Frontiers in Higher Education, No.3, pp.1-35.
23. Durkheim,Emile, 1956, Education and Sociology, New York, Free Press.
24. Friere, Paulo, 1972, Pedagogy of the Oppressed, Harmondsworth: Penguin Books.
25. Halsay, A.K. et.al., 1961, Education, Economy, and Society: A reader in the Sociology of Education, New York: Free Press.
26. Jayaram, N, 1990, Sociology of Education in India, Jaipur: Rawat Publication.
27. Jefferey, R. and Alaka M. Basu, 1996, Girls' Schooling, Women's Autonomy and fertility Change in South Asia, New Delhi: Sage.
28. Kamat, A.R., 1985, Education and Social Change in India, Bombay: Somaiya.
29. Karabel, J. and A.H. Halsey (eds.) 1977, Powers and Ideology in Education, New York: OxfordUniversity Press.
30. Naik, J.P., 1975, Quality, Quantity and Equality in Education, Naw Delhi: Allied Publishers, Whole Book.
31. Tyler, William, 1977, The Sociology of Educational Inequality, London: Methuen.

MANDATORY RM

Important Note: Mandatory RM Course (i.e. Research Methodology) has two options, i.e. Quantitative Method in Social Research and Qualitative Method in Social Research. Student can opt that RM Course which he/she has to be applying in his/her research project of Semester Three and Semester Four of this PG program.

PAPER CODE : PGSO1M09

RM1 : QUANTITATIVE METHOD IN SOCIAL RESEARCH

Unit 1. Understanding Social Research:

A. Meaning and nature of social research, research ethics and plagiarism

B. Formulation of problem in social research, social survey and social research, research review and research gap

C. References and citation in social research: APA, MLA,etc.

Unit 2. Quantitative Social Research:

A. Objectives and hypotheses

B. Exploratory, descriptive, diagnostic and experimental designs

C. Sampling methods: Techniques and types

Unit 3. Methods of Data Collection in Quantitative Research:

A. Observation: Participatory and Non-participatory, merits and demerits

B. Questionnaire: Open and close ended questions, merits and demerits of questionnaire

C. Structured interview: its merits and demerits

D. Use of Digital tools: Google Form, Survey Sparrow, Formplus, JotForm, Epocollect5

Unit 4. Analysis and Interpretation of Data in Quantitative Research:

A. Use of SPSS in Calculation of Central Tendencies, Standard deviation and Correlations

B. Issues in the presentation and interpretation of quantitative data

C. Testing of hypothesis

Suggested Readings:

1. Wilkinson, T. S., and P. L. Bhandarkar., Methodology and Techniques of Social Research,

Himalaya Publishing House, Mumbai, (Reprint, 2004)
2. Bryman, Alan, Quality and Quantity in Social Research, UnwinHyman, London, 1988.
3. Hughes, John., The Philosophy of Social Research, Longman, London, 1987.
4. D.A.de Vaus, Surveys in Social research, George Relen and Unwin, London, 1986.
5. Bose, Pradip Kumar, Research Methodology, ICSSR, New Delhi.
6. Madge, John., The Origins of Scientific Research, Tavistock, London,1970.
7. Punch, Keith, Introduction to Social Research, Sage Publications, New Delhi, 1986.
8. Srinivas, M.N. and A.M. Shah, Field Worker and the Field, Oxford University press, New Delh, 1979.
9. Beteille A., and T.N. Madan, Encounter and Experience:Personal Accounts of Fieldwork, Vikas Publishing House Pvt. Ltd., New Delhi, 1975.
10. Barnes, John A., Who Should Know What? Social Science, Privacy and Ethics, Harmondsworth, Penguin, 1979.
11. Mukherjee, P.N., Methodology in Social Research: Dilemma and Perspectives, Sage Publications, New Delhi, 2000.
12. Shipman, Martin, The limitations of Social Research,Longman, London, 1988.
13. Sjoberg, Gidden and Roger Nett., Methodology for Social Research, Rawat publications, Jaipur.
14. Smeler, Neil J., Comparative Methods in Social Science.
15. Garett, Henry. E., Statistics in Psychology and Education, David Mckay, Indian Publication, Bombay, Tenth Reprint, 1981.
16. Moser, C.A., Survey Methods in Social Investigation, Heinemann, 1971.
17. Somekh, B and Lewin, C., (eds.), Research Methods in Social Sciences, Vistaar Publication, New Delhi, 2005.
18. Giri, Ananta K., (ed.), Creative Social Research: RethinkingTheories and Methods, Vistaar Publication, New Delhi, 2004.
19. Whyte, W.F., Street Corner Society.
20. Daniel Bell, Doing Sociological Research.
21. Bhandarkar, P.L., Samajik Sanshodhan Padhati (Marathi).

PAPER CODE : PGSO1M09

RM2 : QUALITATIVE METHOD IN SOCIAL RESEARCH

1. **Introduction to Qualitative Research:**
   A. Difference between Quantitative and Qualitative Research, triangulation of method
   B. Ethics in qualitative research
   C. Research questions: Types, sensitizing concept and concept map

2. **Research Designs in Qualitative Research:**
   A. Construction of Research Design: Components, Linear and Circular Process
   B. Case Studies, Comparative Studies, Retrospective Studies, Oral History
   C. Snapshot and Longitudinal studies

3. **Sampling and Data Collection:**
   A. Theoretical sampling, Purposive sampling and Focus groups
   B. Interviews: Focused, Semi-Standardized, Problem-centered, Expert and Ethnographic, In-depth interviews, Narrative Interviews, Episodic Interviews
   C. Digital Research data tools: VisionsLive, LiveMinds, Kernwert, FocusVision, FlexMR, itracks, Recollective

4. **Analysis and Interpretation:**
   A. Documentation: Transcription, coding-types and content analysis
   B. Data analysis: theoretical triangulation Content Analysis, techniques and tools, Atalas-ti, NVivo
   C. Issues in presenting, analyzing and interpreting qualitative data

Suggested Readings:

1. Wilkinson, T. S., and P. L. Bhandarkar., Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai, (Reprint, 2004)
2. Hughes, John., The Philosophy of Social Research, Longman, London, 1987.
3. D.A.de Vaus, Surveys in Social research, George Relen and Unwin, London, 1986.
4. Bose, Pradip Kumar, Research Methodology, ICSSR, New Delhi.
5. Madge, John., The Origins of Scientific Research, Tavistock, London,1970.
6. Barnes, John A., Who Should Know What? Social Science, Privacy and Ethics, Harmondsworth, Penguin, 1979.
7. Mukherjee, P.N., Methodology in Social Research: Dilemma and Perspectives, Sage Publications, New Delhi, 2000.
8. Moser, C.A. and Kalton, G, Survey Methods in Social Investigation, Heinemann, 1971.
9. Bhandarkar, P.L., Samajik Sanshodhan Padhati (Marathi).

SEMESTER: II

MANDATORY PAPERS

PAPER CODE : PGSO2M01

CONTEMPORARY SOCIOLOGICAL THEORY

Unit 1. Structuralism:

A. A.R. Radcliffe-Brown : Anthropological Perspective

B. Claude Levi-Strauss : Language, Mind and Society

Unit 2. Functionalism:

A. Bronislaw Malinowski : Anthropological Approach

B. Robert K. Merton : Paradigms and Codification

C. Talcott Parsons : Analytical Functionalism

Unit 3. Conflict Theory :

A. Ralf Dahrendorf : Conflicts in Industrial Society

B. Lewis Coser : Conflict Functionalism

Unit 4. Symbolic Interactionism

A. G.H. Mead : Mind, Self and Society

B. Erving Goffman : Dramaturgy

Suggested Readings:

1. Ritzer, George. Sociological Theory, Mac-Graw-Hill, 2000.
2. Ritzer, George. Encyclopedia of Social Theory. Vol.I&II. Sage Pub. 2005.
3. Giddens and Turner (eds.). Social Theory Today, Cambridge: Polity Press, 1987.
4. Abraham, M.F. Modern Sociological Theory, New Delhi: OUP. 1990.
5. Haralambos and Holborn. Sociology: Themes and Perspective. Fifth Edition, Collins, 2000.
6. Calhoun, Craig, Rojek, Chris & Bryan Turner. The Sage Handbook of Sociology, Sage Publications, 2005.
7. Ritzer, George and Barry Smart. Handbook of Social Theory, Sage Publications, 2001.
8. Ruth A. Wallace and Alison Wolf. Contemporary Sociological Theory, 6th Edition, Eastern Economy Edition, Prentice-Hall of India, New Delhi, 2008.
9. David Ashley and David, Michael Orenstein. Sociological Theory, Sixth Edition, Pearson Education, 2005.
10. Tim Delaney. Contemporary Social Theory, Pearson Education, 2008.
11. Jonathan, H. Turner. The Structure of Sociological Theory, Rawat Publications, Jaipur, 1987.
12. Anthony Elliott. Contemporary Social Theory, London: Routledge and Kegan Paul, 2009, Indian Reprint, 2010

PAPER CODE : PGSO2M02

PERSPECTIVES ON INDIAN SOCIETY - II

Unit 1. Social Change in Indian Society

A. **Avijit Pathak:** Secular Modernity, Culture as an Arena of Struggle.

B. **Dipankar Gupta** : Modernization of Social, Economic and Political Life

Unit 2. Perspectives on Development

A. **Amartya Sen:** Development as Freedom, Capability, Choice and Social Welfare.

B. **Abhijeet Banerjee:** Experimental Approach in Development Economics, Development and Poverty Elevation, Universal Ultra Basic Income.

Unit 3. Power Politics and Social Change

A. **A R Desai:** Social Background of Indian Nationalism, Peasant Struggles and Transformation

B. **M.K. Gandhi:** Swadeshi, Satyagrah, Basic Education, Issue of untouchability

Unit 4. Civilization Perspective

A. **Surjit Sinha:** Tribe-Caste Continuum, Tribe-Peasant Continuum. Tribal Movements.

B. **N.K. Bose :** Indian civilization and tribal assimilation in Hindu main stream

Suggested Readings

1. Surinder Jodhka, (2013) Interrogating India's Modernity: Democracy, Identity, and Citizenship, Oxford University Press.
2. Pathak Avijit. 1998, Indian Modernity, Aakar Books.
3. Pathak Avijit. 2006, Modernity Globalization and Identity, Aakar Books.
4. Hamilton Lawrence. 20200 How to read Amartya Sen, Penguin Random House
5. Banerjee Abhijit; Duflo Esther. 2011, Poor Economics: Rethinking Poverty & the Ways to End it, Penguin Books.
6. Banerjee Abhijit; Duflo Esther. 2019, Good Economics for Hard Times: Better Answers to Our Biggest Problems. Juggernaut.
7. Rege Sharmila. 2006, Writing Caste/Writing Gender, Zubaan Publication.
8. Rege Sharmila. 2018. Gendering Caste: Through A Feminist Lens, Sage.
9. Rege Sharmila. 2003, Sociology of Gender: The Challenge of Feminist Sociological Thought, Sage.
10. Uberoi Patricia. 1997, Family Kinship and Marriage in India, OUP.
11. Bhasin Kamla. 2000, Understanding Gender, Kali for women.
12. Bhasin Kamla. 2004, Exploring Masculinity, Women Unlimited.

13. Gopal Guru, Sundar Sarukkai. 2019 Experience, Caste, and the Everyday Social, Oxford University Press.
14. Gopal Guru, Sundar Sarukkai. 2018, The Cracked Mirror: An Indian Debate on Experience and Theory, Oxford University Press.
15. Xaxa Virginius. 2008, State, Society and Tribes: Issues in Post-Colonial India, Pearson.
16. Xaxa Virginius. 2012, Social Exclusion and Adverse Inclusion: Development and Deprivation of Adivasis in India (Ed.), OUP.
17. Xaxa Virginius & Jagannath Ambagudia. 2020, Handbook of Tribal Politics in India. Sage.
18. DeSouza, P.R. (ed), 2000, Contemporary India-Transitions, New Delhi, Sage.
19. Dhanagare, D.N. 1993, Themes and Perspectives in Indian Sociology, Jaipur, Rawat.
20. Dube, S.C. 1973, Social Sciences in a Changing Society, LucknowUniversity Press.
21. Dube, S.C. 1967, The IndianVillage, London, Routledge, 1955,
22. Karve, Irwati. 1961, Hindu Society: An Interpretation, Poona, DecanCollege.
23. Momin, A.R. 1996, The Legacy of G.S. Ghurye: A Centennial Festschrift, Popular Prakashan, Bombay.
24. Mukherjee, D.P. 1958, Diversities, People's Publishing House, Delhi.
25. Singh, Y. 1986, Indian Sociology: Social Conditioning and Emerging Concerns, Delhi Vistaar.
26. Singh, Y. 1973, Modernization of Indian Tradition, Delhi, Thomson Press.
27. Srinivas, M.N. 1960, India"s Villages, Asia Publishing House, Bombay.
28. Tylor, Stephen: India;An Anthropological Perspective.
29. Guha, Ranjit (ed), 1982, Subaltern Studies: Writings on South Asian History and Society, Oxford.
30. Desai, A.R. 1948, Social Background of Indian Nationalism, Popular, Bombay.
31. Ambedkar, B.R. Speeches and Letters, Bombay.
32. Sinha, Surajit. 1980, Tribes and Indian Civilization, in Manin India.
33. Bose, Nirmal Kumar, Problems of Indian Nationalism, Calcutta.
34. Singhi, N.K.1996, Theory and Ideology in Indian Sociology, Rawat, Jaipur.

PAPER CODE : PGSO2M03

SOCIOLOGY OF CHANGE AND DEVLOPMENT

Unit 1. Understanding Social Change:

A. Related concepts of social change: evolution, progress, growth, development and transformation

B. Theories of social change: socio-psychological and conflict theories

C. Factors of social change: demographic, economic, religious, bio-tech, info-tech and media

Unit 2. Processes of Social Change in Contemporary India:

A. Sanskritization and Westernization

B. Modernization and Secularization

C. Industrialization, Migration and Urbanization

Unit 3. Approaches to Development:

A. Modernization approach

B. Dependency approach

C. Neo-liberal approach (MNCs, TNCs, WTO)

Unit 4. Social Structure and Development:

A. Structure as a facilitator/inhibitor of development

B. Culture as an aid or impediment to development

C. Development and displacement, sustainable development

Suggested Readings:

1. Bryce F. Ryan. Social and Cultural Change, The Ronald Press Company, New Tork, 1969.
2. Wood Charles, Roberts Bryan (ed), 2005, Rethinking Development in Latin America, Peen State Press.
3. Preston P.W., 1982, The Theories of Development, London Routledge, Kegan Paul.
4. Abraham, M.F., 1990, Modern Sociological Theory: An Introduction, New Delhi, OUP.
5. Agarwal, B., 1994, A Field of One's Own: Gender and Land Rights in South Asia, Cambridge, Cambridge University Press.
6. Appadurai, Arjun, 1997, Modernity at Large: Cultural Dimensions of Globalization, New Delhi, OUP.
7. Dereze, Jean and Amartya Sen, 1996, India: Economic Development and Social Opportunity, New Delhi, OUP.
8. Desai A.R., 1985, India's Path of Development: A Marxist Approach, Bombay, Popular Prakashan (Chapter 2).9. Desai A.R., 1971, Essays on Modernization of Underdeveloped Societies, Thacker and Co, Bombay.
9. Giddens Anthony, 1996, "Global Problems and Ecological Crisis", in Introduction to Sociology, IInd Edition, New York, W.W. Norton & Co.

11. Harrison, D., 1989, The Sociology of Modernization and Development, New Delhi, Sage.

12. Haq, Mahbub Ul, 1991, Reflections on Human Development, New Delhi, OUP.
13. Moore Wilbert E., and Robert Cook, 1967, Social Change, New Delhi, Prentice-Hall of India.
14. Sharma S.L., 1980, "Criteria of Social Development", Journal of Social Action, Jan-Mar.
15. Sharma S.L., 1986, Development: Socio-Cultural Dimensions, Jaipur, Rawat (Chapter I).
16. Sharma S.L., 1994, "Salience of Ethnicity in Modernization: Evidence from India", Sociological Bulletin, Vol.39, Nos. 1 & 2. pp. 33-51.
17. Srinivas M.N., 1966, Social Change in Modern India, Berkley, University of Berkley.
18. Symposium on Implications of Globalization, 1995, Sociological Bulletin, Vol.44, (Articles by Mathew, Panin and Pathy).
19. UNDP. Sustainable Development, New York, OUP.
20. World Bank. 1995, World Development Report, New York.
21. Amin, Samir, 1979, Unequal Development, New Delhi, OUP.
22. Giddens Anthony, 1990, The Consequences of Modernity, Cambridge, Polity Press.
23. Kiely, Ray and Phil Marfleet (eds.), 1998, Globalization and the Third World, London, Routledge.
24. Sharma, S.L., 1992, "Social Action Groups as Harbingers of Silent Revolution", Economic and Political weekly, Vol. 27, No. 47.
25. Sharma, S.L., 1994, "Perspectives on Sustainable Development in South Asia: The Case of India" in Samad (ed.), Perspectives on Sustainable Development in Asia, Kuala Lumpur, ADIPA.
26. Sharma, S.L., 2000, "Empowerment Without Antagonism: A Case for Reformulation of Women's Empowerment Approach", Sociological bulletin, Vol.49., No.1.
27. UNDP. 1997, Human Development Report, New York, Oxford University Press.
28. Wallerstein Immanual, 1974, The Modern World System, New York, OUP.
29. Waters, Malcoln, 1995, Globalization, New York, Routledge and Kegan Paul.
30. World Commission on Environment and Development, 1987, Our Common Future, (Brundland Report), New Delhi, OUP.
31. Daniel Lerner. The Passing of Traditional Society, Glencoe: The Free Press, 1958.
32. Alan Peshkin and Ronald Cohen. The Values of Modernization, Journal of Developing Areas, Vol. 2, 1967.
33. Leslie A. White. The Evolution of Culture: The Development of Civilization to the Fall of Rome, New York: McGraw-Hill, 1959.
34. Julian Steward. Theory of Culture Change: The Methodology of Multilinear Evolution, University of Illinois Press, 1955.
35. Alex Inkeles, The Modernization of Man, in Rajendra Pandey (ed.), Modernization and Social Change, Criterion Publications, New Delhi, 1988.
36. Myron, Weiner. Modernization: The Dynamics of Growth (ed.), New York: Basic Books, 1966.
37. S.C. Dube. Modernization and its adaptive Demands on Indian Society, in Rajendra Pandey (ed.), Modernization and Social Change, Criterion Publications, New Delhi, 1988.
38. S.C. Dube, Understanding Change, Vikas Publishing House Pvt. Ltd., New Delhi, 1992.
39. Haralambos and Holborn. Sociology: Themes and Perspective. Fifth Edition, Collins, 2000.
40. Moor, Wilbert and Robert Cook, Social Change, New Delhi: Prentice-Hall of India, 1967.

PAPER CODE : PGSO2M04

SOCIOLOGY OF RELIGION - II

Unit 1. Religion in Contemporary Society:

A. Jürgen Habermas: The place of religion in rational dialogue

B. Niklas Luhmann: Religion as function

C. Peter L. Berger and Thomas Luckmann: Religion as social construction

D. Pierre Bourdieu: Religion and social practice

Unit 2. Religion in Public Sphere:

A. Religious nationalism

B. Religion and political power

C. Religious movements

D. Proselytism

Suggested Readings:

1. Weber, M. The Sociology of Religion, Boston, Mass: Beacon Press, 1963.
2. Eliade, H. The Sacred and the Profane: The Nature of Religion, New York: Harcourt, Brace and World, 1959.
3. Durkheim, E. The Elementary Forms of Religious Life, London: Allen and Unwin, 1915.
4. Fischer, M.N.J. Iran: From Religious Dispute to Revolution, Cambridge, Mass: Harvard University Press, 1980.
5. Baird, Robert D, (ed.) 1995 (3rd edition) Religion in Modern India, Delhi, Manohar.
6. Jones, Kenneth W., 1989, Socio-Religious Reform Movements in British India, The New Cambridge History of India III - I),Hyderabad, Orient Longman.
7. Madan T.N. (ed.) 1992, (enlarged edition), Religion in India, New Delhi, Oxford Press.
8. Mazumdar H.T., 1986, India"s Religious Heritage, New Delhi, Allied Publishers.
9. Roberts, Keith A., 1984, Religion in Sociological Perspective, New York, Dorsey Press.
10. Shakir Moin (ed.) 1989, Religion, State and Politics in India, Delhi,Ajanta Publications.
11. Turner Bryan. S., 1991 (2nd edition) Religion and Social Theory, London, Sage Publications.
12. Robinson, Rowena, 2004, Sociology of Religion in India, Sage, India.

ELECTIVE COURSES

Important Note : Continue your elective's group in second seminar. For example, if you opt G1P1 in first semester, then opt G1P2 in second. It is equally applicable to all four groups.

PAPER CODE : PGSO2E05

G1P2 : RURAL AND URBAN TRANSFORMATION

Unit I : Changing Rural Community

A. Changing Inter-Community Relations - Decline of Jajmani System, From Caste to Class, Impact of Globalization and Democratic Politics, Caste violence, Caste-Tribal Conflicts

B. Caste-Tribal Settlement - Ruaralization of Tribes, Migration of Tribes-Castes, Secured Forests, Mutual Adaptations

Unit II : Changing Agrarian System

A. Changing Agrarian Economy - Decline of Agrarian System, Factors of De-Peasantization of Rural Population and impact, Factors of Migration to cities and Impact.

B. Changing Agrarian Relations - Factors responsible for Changing Agrarian Social Structure, Inter-community relations and violence. Land Ownership & Change in Agrarian Relations, Emergence of Class relations in rural society, Agrarian Unrest and Peasant Movements

Unit III : Changing Urban Community

A. Urbanism - Concept and Meaning, Development of Urbanity, Factors and Impact Urbanization

B. Towns, Cities and Mega-Cities - Concepts, Development and Variance in Issues, Industries, Service Sectors and Businesses as Factors and Network-Builder of Urbanization.

Unit IV : Changing Human Relations in Urban Society

A. Urban Middle Class - Factors of Emergence and its Impact. Township - Emergence of Gated Communities and Exclusiveness. Changing Neighborhood within gated communities.

B. Slums - Factors of Development and issues. Bastis in Cities - Ethnic, Class, Religion and Caste based issues of settlement of Bastis. Different Urban Movements and Urban Violence

Suggested Reading:

1. Beyond Hindu and Muslim: Multiple identity in Narratives from village India, Peter Gottschalk, OUP, 2000
2. Caste, Class and Power, Andre Beteille, University of California Press, 1965
3. New Directions in the Sociology of Global Development, Vol 11, Fredrick H. Buttel & Philip McMichael, Elsevier, Amsterdam, 2005
4. City, Phil Hubbard, Routledge, New York, 2006

Urbanization unlimited: A Thematic Journey, Johannes Fiedler, Springer, New York, 2004

5. The City , Gary Bridge & Sophie Watson, Wiley-Blackwell, Chichester, 2011
6. Cosmopolitan Urbanism, J. Binnie, J. Holloway and others, Routledge, London, 2006
7. Cities and Urban Cult

PAPER CODE : PGSO2E06

G2P2 : WOMEN IN INDIAN SOCIETY

Unit 1. The Changing Profile of Women in India:

A. The changing status of women in pre-colonial, colonial and post-colonial India

B. The demographic profile - the gender gap (Census, NSS) C. Gender in caste, class and religion

Unit 2. Patriarchy and Women in India:

A. Women's role in decision making: family, health and reproductive behavior.

B. Women's situation in India: Socio-cultural taboos, economic and political deprivation, sexual exploitation, etc.

Unit 3. Women and Social Institutions:

A. Education: Gender based participation in educational institutions

B. Economy: Sexual division of labour, unequal payments, and marginalization of women

C. Polity: Gender based participation in politics; reservations for women and political empowerment

Unit 4. Women and Social Issues:

A. Development

B. Communalism

C. Crime and violence

D. Education, employment and empowerment

Suggested Readings:

1. Altekar, A.S., 1983, The Position of Women in Hindu Civilization, Delhi, Motilal Banarasidas, Second Edition, Fifth Reprint.
2. Chodrow, Nancy, 1978, The Reproduction of Mothering, BerkelyUniversity of California Press.
3. Desai Neera and M Krishnaraj, 1978, Women and Society in India, Delhi, Ajanta.
4. Dube Leela et al (eds.) 1986, Visibility and Power: Essays on Women in Society and Development, New Delhi, OUP.
5. Forbes G., 1998, Women in Modern India, New Delhi, Cambridge University Press.
6. Maccoby, Eleaner and Carol Jackin, 1975, The Psychology of Sex Differences, Stanford, Stanford University Press.
7. Mc Cormack, C and M. Strathern (ed.) 1980, Nature, Culture and Gender, Cambridge, CambridgeUniversity Press.
8. Myers, Kristen Anderson et al, (eds.) 1998, Feminist Foundations: Towards Transforming Sociology,New Delhi, Sage.

9. Oakely, Ann., 1972, Sex, Gender and Society, New York, Harper and Row.
10. Sharma, Ursula, 1983, Women, Work and Property in North-West India, London, Tavistock.
11. Shulamitz, Reinharz and Lynn Davidman, 1991, Feminist Research Methods, New York, OxfordUniversity Press.
12. Srinivas, M.N., Caste Its Modern Avatar, New Delhi, Penguin (Leela Dube"s Article on Caste and Women)
13. Vaid, S and K Sangari, 1989, Recasting Women Essays in Colonial History, New Delhi.
14. Agarwal, B, 1994, A Field of One"s Own Gender and Land Rights in South Asia, Cambridge University Press.
15. Channa Karuna, 1988, Socialization, Women and Education: Explorations in GenderIdentity, New Delhi, Orient Longman.
16. Dube Leela, 1997, Women and Kinship: Comparative Perspectives on Gender in South and South-East Asia, Tokyo, United Nations University Press.
17. Gandhi, N and N. Shah, 1992, The Issues at Stake: Theory and Practice in the
Contemporary Women"s Movement in India, New Delhi.
18. Ghadially, Rehana, (ed.) 1988, Women in Indian Society, New Delhi, Sage.
19. Jaywardene, Kuman, 1991, Feminism and Nationalism in the Third World, New Delhi.
20. Miss Maria, 1980, Indian Women and Patriarchy: Conflicts and Dilemmas of Students and Working Women, New Delhi, Concept.
21. Omvedt Gali, 1975, Caste, Class and Wome"s Liberation in India, Bulletin of Concerned Asian Scholars.
22. Pardeshi, Pratima, 1988, Dr. Ambedkar and the Question of Women"s Liberation in India, Pune, WSC, University of Pune.

PAPER CODE : PGSO2E07

G3P2 : SOCIAL MOVEMENTS IN INDIA

Unit 1. Understanding Social Movements in India:

A. History and origin of social movements in India

B. Causes and consequences of social movements

C. Caste, class and social movements in India

Unit 2. Traditional Social Movements:

A. Peasant and tribal Movements

B. Women's movement

C. Trade union and nationalist movements

Unit 3. New Social Movements:

A. Dalit and ethnic movements

B. Students' Movements

C. Ecological and environmental movements

Unit 4. Consequences of Social Movements:

A. Social movements, state and civil Society in India

B. Social movements, social change and development

Suggested Readings:

1. Banks, J.A., 1972, The Sociology of Social Movements, London, Macmillan.
2. Desai, A.R., (ed.) 1979, Peasant Struggles in India, Bombay, OxfordUniversity Press.
3. Dhanagare D.N., 1983, Peasant Movements in India 1920-1950, Delhi, OUP.
4. Gore M.S., 1993, The Social Context of an Ideology: Ambedkar's Political and Social Thoughts, New Delhi, sage.
5. Oommen T.K., 1990, Protest and Change: Studies in Social movements, Delhi, Sage.
6. Rao M.S.A., 1979, Social Movements in India, New Delhi, Manohar.
7. Singh K.S., 1982, Tribal Movements in India, New Delhi, Manohar.
8. Selliot Eleanor, 1995, From Untouchable to Dalit: Essays on the Ambedkar Movement, New delhi, Manohar.
9. Gouldner A.W., 1950, (ed.) Studies in Leadership, New York, Harper and Brothers.
10. Oommen T.K., 1972, Charishma, Stability and Change: An Analysis of Bhoodan Gramdan Movement, New Delhi, Thomas Press.
11. Shah Ghanshyam, 1990, Social movements in India: A Review of the Literature, Delhi, Sage.

12. Shah Nandita, 1992, The Issues at Stake: Theory and Practice in the Contemporary Women's Movements in India.
13. Shiva Vandana, 1991, Ecology and the Politics Survival, New Delhi, Sage

PAPER CODE : PGSO2E08

G4P2 : EDUCATION AND SOCIETY IN INDIA

Unit 1. Socio-historical Context of Education in India:

A. Education in pre-colonial and colonial India

B. Education in post-colonial and modern India

C. Significance of education in India

Unit 2. Equality of Educational Opportunity:

A. Educational diversities and disparities: region, tribe, caste, gender and rural urban community

B. Equity and equality: positive discrimination and constitutional provisions

C. Debate of equity, excellence and efficiency

Unit 3. Issues in education:

A. Privatization of education

B. Intervention of state in education

C. Education, scientific attitudes and modernization

Unit 4. State and Education in India:

A. Basic education and social development

B. Education: skill development, globalized market and social mobility

C. Crisis in higher education system, governance and finance

Suggested Readings:

1. Haralambos, Michael, Martin Holborn and Robin Heald, 2000, Sociology: Themes and Perspectives, Fifth Edition, Collins, London.
2. Acker, S, 1994, Gendered Education: Sociological Reflections on Women,, Buckinghum: Open University Press.
3. Banks, Olive, Sociology of Education, (2nd Ed.), London: Batsford, 1971.
4. Banks, James A. and Lynch, James (eds.) 1986, Multicultural Education in Western Societies, London: Holt Saunders.
5. Blackledge, D. and Hunt, B., 1985, Sociological Interpretations of Education, London: Crom Helm.
6. Brint, Steven, 1998, Schools and Societies, Thousand Oaks, Calif: Pine Forge Press, A Division of Sage.
7. Uttam B. Bhoite, 2009, Higher Education in India: A System on the Verge of Chaos, Sociological Bulletin, Vol.58, No.2, May-August.
8. Channa, Karuna, 1988, Socialization, Education and Women: Explorations in Gender Identity, New Delhi: Orient Longman.
9. Chanana, Karuna, 1979, „Towards a Study of Education and Social Change". In Economic and Political Weekly, 27, 14 (4): 157-64.
10. B.K. Swain, 1998, Changing Occupational Structure in Vidarbha, India, Himalaya Publishing House, Mumbai.

11. Chitnis, Suma and P.G. Albach, 1993, Higher Education Reform in India, Experience and Perspectives, New Delhi: Sage.
12. Craft, Maurice, (e.d), 1970, Family, Class and Education: A Reader, London: Longman.
13. Dreze, Jean and Amartya Sen, 1995, Indian Economic Development and Social Opportunity, Oxford: Oxford University Press.
14. Gandhi, M.K., 1962, Problems of Education< Ahmedabad: Navjeevan Prakashan.
15. Gore, M.S. et.al. (ed.), 1975, Papers on the Sociology of Education in India, New Delhi, NCERT.
16. Halsey, A.H., Hugh Lander, Phillips Brown and Amy S. Wells, 1997, Education, Culture, Economy and Society, Oxford, Oxford University Press.
17. Jejeebhoy, Shireen, 1995, Women's Education, Autonomy and Reproductive Behaviour, Oxford: Clarendon Press.
18. Meighan, Ronald and Iram Siraj- Blatchford, 1997, A Sociology of Educating, London: Cassell, Third Edition.
19. Robinson, P., 1987, Perspectives in the Sociology of Education: An Introduction, London: Routledge and Kegan Paul.
20. Sen, Amartya, 1992, Inequality re-examined, Delhi: Oxford University Press.
21. Shatrugan, M., 1988, Privatising Higher Education, EPW. Pp. 2624.
22. Ahmad Karuna, 1984, Social Context of Women's Education 1921-81, New Frontiers in Higher Education, No.3, pp.1-35.
23. Durkheim,Emile, 1956, Education and Sociology, New York, Free Press.
24. Friere, Paulo, 1972, Pedagogy of the Oppressed, Harmondsworth: Penguin Books.
25. Halsay, A.K. et.al., 1961, Education, Economy, and Society: A reader in the Sociology of Education, New York: Free Press.
26. Jayaram, N, 1990, Sociology of Education in India, Jaipur: Rawat Publication.
27. Jefferey, R. and Alaka M. Basu, 1996, Girls' Schooling, Women's Autonomy and fertility Change in South Asia, New Delhi: Sage.
28. Kamat, A.R., 1985, Education and Social Change in India, Bombay: Somaiya.
29. Karabel, J. and A.H. Halsey (eds.) 1977, Powers and Ideology in Education, New York: OxfordUniversity Press.
30. Naik, J.P., 1975, Quality, Quantity and Equality in Education, Naw Delhi: Allied Publishers, Whole Book.
31. Tyler, William, 1977, The Sociology of Educational Inequality, London: Methuen.

MANDETORY : FP

PAPER CODE : PGSO2M09

FIELD PROJECT

Directions :

1. To Develop Understanding of Sociological Concept, Methodology and Theory with field interaction/Induction (Practical assignment)
2. Field Project must be 4 credits (120 hours: 2 days orientation before field induction, 16 days field engagement (6 hours per-day), Report writing, Presentation, and subject viva-voce)
3. Selection of topic - Student should discuss with supervisor and finalize the topic and field area/setting.
4. Orientation about field project - Department/institution should provide orientation workshop for field work, its procedure, report writing, documentations (written, audio-visual, etc.), field-diary, certification, etc.
5. Field work - Field work should be in any community, or with any NGO/GO/CBO, or with any Institution.
6. Report writing -
   A. Daily Report writing: Objectives, Work done, Observation and daily reflection on field
   B. Final Report writing: Field Project report (Introduction of FP, Methodology, Process, Discussion, Outcomes and Concluding remark, learning and critical reflection of sociological thoughts)
7. Field Dairy: It is must for assessment of the students. It should mention reporting time, date and day, write field Notes/points/memos during field interaction.
8. Attendance and Certification (for 96 hours field engagement): Student should submit the certificate from authority where he/she/they complete his/her/their field-work, viz. Formal head (Sarpanch/Member of Municipal Corporation etc.) of Community or authority of NGO/GO/CBO, or Institution regarding his/her/their attendance and field work in field setting.

SEMESTER: III

MANDATORY PAPERS

PAPER CODE : PGSO3M01

MODERN SOCIOLOGICAL THEORY

Unit 1 : Structuration

A. Anthony Giddens : Agency and Structure

B. Margaret Archer : Culture and Agency

Unit 2. Post-structuralism

A. Jacques Derrida - Signifier, significant & Deconstructionism

B. Michel Foucault - Knowledge and Power, Archaeology of Knowledge

Unit 3. Critical Theories

A. George Lukacs, Antonio Gramsci, Louis Althusser

B. Max Horkhemer, Theodor Adorno, Herbert Marcuse

Unit 4. Phenomenology & Ethnomethodology

A. Phenomenology : Alfred Schutz, Peter Berger

B. Ethnomethodology : Harold Garnfinkel, Clifford Geertz

Suggested Readings:

1. Ritzer, George. Sociological Theory, Mac-Graw-Hill, 2000.
2. Ritzer, George. Encyclopedia of Social Theory. Vol.I&II. Sage Pub. 2005.
3. Giddens and Turner (eds.). Social Theory Today, Cambridge: Polity Press, 1987.
4. Abraham, M.F. Modern Sociological Theory, New Delhi: OUP. 1990.
5. Haralambos and Holborn. Sociology: Themes and Perspective. Fifth Edition, Collins, 2000.
6. Calhoun, Craig, Rojek, Chris & Bryan Turner. The Sage Handbook of Sociology, Sage Publications, 2005.
7. Ritzer, George and Barry Smart. Handbook of Social Theory, Sage Publications, 2001.
8. Ruth A. Wallace and Alison Wolf. Contemporary Sociological Theory, 6th Edition, Eastern Economy Edition, Prentice-Hall of India, New Delhi, 2008.
9. David Ashley and David, Michael Orenstein. Sociological Theory, Sixth Edition, Pearson Education, 2005.
10. Tim Delaney. Contemporary Social Theory, Pearson Education, 2008.
11. Jonathan, H. Turner. The Structure of Sociological Theory, Rawat Publications, Jaipur, 1987.
12. Anthony Elliott. Contemporary Social Theory, London: Routledge and Kegan Paul, 2009, Indian Reprint, 2010

PAPER CODE : PGSO3M02

FEMINIST SOCIOLOGICAL THINKERS

Unit 1 : Classical Liberal Feminism

A. Simone de Beauvoir : The Second Sex - existentialist perspective

B. Betty Friedan : The Feminist mystique and critique on Freud

Unit 2 : Radical Feminism

A. Kate Millett : Politics and Revolution of Sexuality

B. Shulamith Firestone Reconstruction of Historical Materialism and Dialectics of Sex

Unit 3 : Marxist and Socialist Feminism

A. Juliet Mitchell : Women's Estate, Psychoanalysis and Feminism

B. Sheila Rowbotham : Critique of Marxism and Marxist Feminism

Unit 4 : Post Modern and Black Feminism

A. Judith Butler : Deconstruction of Sex and Gender, Politics of Gender

B. Issues in Black feminism and inequality in oppression

Suggested Reading

Simon de Beauvoir, The Second Sex, Penguin Books, (1981)

Simon de Beauvoir, The Ethics of Ambiguity, Philosophical Library, New York (1947)

Shulamith Firestone, the Dialectics of Sex : The case for Feminist Revolution, Frogmore, Paladin

Betty Friedan, The Famine Mystique, Penguin, Harmondsworth, 1979

Betty Friedan, The Second Stage, Summit Books, New York, 1981

Kate Millett, Sexual Politics, Ballantine Books, New York, 1980

Juliet Mitchell, Women's Liberation, Marxism and the Socialist Family, in Bikku Parekh's the Concept of Socialism, Ambika Publication, Delhi, 1976

Juliet Mitchell, Psychoanalysis and Feminism, Penguin Books, Harmondsworth, 1974

Juliet Mitchell, Women the Longest Revolution, Pantheon Books, New York, 1984

Sheila Rowbotham, Socialist Feminism, Pluto Press, London, 1978

Sheila Rowbotham, Women, Resistance and Revolution, The penguin, London, 1972

Stevi Jackson and Jackie Jones, Contemporary Feminist Theories, Rawat, Jaipur, 2011

Stanlie James and Abena Busia, Theorizing Black Feminism, Routledge, 1993

Sara Salih, Judith Butler, Routledge, New York, 2002

Gill Jagger, Judith Butler: Sexual Politics, Social Change and Power of Performative, Routledge, 2008

PAPER CODE : PGSO3M03

GLOBALIZATION AND SOCIETY

Unit 1. Understanding Globalization:

A. Concept: definition and distinctive characteristics of globalization

B. Processes of globalization: Westernization, Easternization, Americanization and Anti-Americanization

Unit 2. Global Structure:

A. Neo-liberalism and Neo-Marxian alternatives, nation-state, imagined community

B. Civil Society, cultural hybridization, cultural convergence

Unit 3. Agencies of Globalization

A. Economic agencies, viz. Multinational Corporations (MNCs), WTO; Political agencies, viz. Government & Non-Governmental Organizations (NGOs)

B. Cultural Agencies: Mass Media & ICT

Unit 4. Challenges of Globalization:

A. Inequality, poverty, rural-urban &, majority-minority divide

B. Religious fundamentalism, conflict over natural resources

Suggested Readings:

1. Appadurai, Arjun, 1997, Modernity at Large: Culture Dimensions of Globalization, New Delhi, OxfordUniversity Press.
2. Applebaum R. and Robbison W., 2005, Critical Global Studies Routledge, New York.
3. Cohen Robin and Shirin M, (ed), Global Social Movements, The Athlone Press, London.
4. Dubhashi P.R., 2002, Peoples Movement against Globalism Capitalism: EPW Feb. 9,
5. Drezem Jean and Amartya Sen, 1996, Indian Economic Development and Social Opportunity, Delhi, OUP.
6. Giddens Anthony, 2000, Runawat World: How globalization is reshaping our lives, Routledge, New York.
7. Escobar, Arturo, 1995, Encountering Development: The Making and Unmaking of the Third World, Princeton, Princeton University Press.
8. Hoogvelt, Ankie, 1997, Globalization and the Post-Colonial World - The New Political Economy of Development, London, Macmillan.
9. Hoogvelt, Ankie, 1998, The Sociology of Development, London, Macmillan.
10. Jha Avinash, 2000, Background to Globalization, Centre for education and Documentation, Mumbai.
11. Kofman and Young, 2003, Globalization, Theory and Practice, Continuum, London.

12. Kiely, Ray and Phil Marfleet (eds.) 1998, Globalization and the Third World, London, Routledge.
13. Lechner F. and Boli J. (ed), 2000, The globalization, Blackwell Oxford.
14. Preston, P.W., 1996, Development Theory - An Introduction, Oxford, Blackwell.
15. Schuurman Frans J. (ed), 2002, Globalization and Development Studies, Sage Publications, New Delhi.
16. Waters, Malcolm, 1996, Globalization, London, Routledge.

PAPER CODE : PGSO3M04

SOCIAL PROBLEMS IN CONTEMPORARY INDIA

Unit 1. Problem of inequality:

A. Casteism and atrocities: Unequal distribution of power, oppression and discrimination, caste struggle and atrocities; **Inclusive policy**: Political Reservations and Reservation in education and Government Services, SC & OBC Commission, Atrocity Act

B. Gender inequality: Patriarchal and patrilineal structure and denial of powers & authorities, sex roles, discrimination; socioeconomic-political consequences of sexism, constitutional provisions and gender sensitization

Unit 2. Population, Space and Social problems:

A. Population and Urban Problems: urban transformation due to migration, overpopulation, urban explosion; urban problems: health, habitat, natural resources, socio-economic and political problem; rapid modernization and use of technology

B. Environment, social problems and solutions to social problems

Suggested Readings:

1. Jogan, Sankar. (ed.), Social Problems and Welfare in India, Ashish, New Delhi, 1992.
2. Madan, G.R. Indian Social Problems, Vol. I and II, Allied, Bombay, 1973.
3. Ahuja, Ram. Social Problems in India, Rawat, Jaipur, 2002.
4. Jain, Prabha Shasi and Singh Mamta. Violence Against Women, Radha, New Delhi, 2001.
5. Mishra, Girish and Pandey Brajkumar. White-Collar Crimes, Gyan, New Delhi, 1998.
6. Ahmad, Siddique. Criminology (5th ed.), Eastern Book Company, New Delhi, 2005.
7. Paranjape, N.P. Criminology (12th ed.), Central, Allahabad, 2005.
8. Attar, Chand. Poverty and Underdevelopment: New Challenges, Gyan, New Delhi.
9. Horton, Paul B and Leslie, Gerald R. The Sociology of Social Problems (Fifth ed.), Prentice-Hall, New Jersey, 1974.
10. Weinberg, M.S., Rubington Earl Sue Kiefer Hammersmith. The Solution of Social Problems-Five Perspectives, (2nd Edition), OUP, New York, 1981.

ELECTIVE COURSES

Important Note : Continue your elective's group in second seminar. For example, if you opt G1P1 in first semester, then opt G1P2 in second and G1P3 in third. It is equally applicable to all four groups.

PAPER CODE : PGSO3E05

G1P3 : SOCIOLOGY OF SOCIAL STRATIFICATION

Unit 1. Understanding Social Stratification:

A. Definition, characteristics and types of social stratification

B. Social Differentiation and Social Stratification

C. Social inequality vs. biological/natural inequality

Unit 2. Theoretical Perspectives on Social Stratification:

A. Functional perspectives: Talcott Parsons, Kingsley Davis & Wilbert E. Moore

B. Conflict perspectives: Karl Marx, Pierre Bourdieu

Unit 3. Class Identity and Culture:

A. Class and Types of Capitals, Attitudes to class and identity,

B. Class ambivalence, Culture and Class Conflict

Unit 4. Social Mobility and Social Stratification:

A. Ascription and Achievement, types of mobility: Absolute, relative, Intergenerational, intra-generational, upward, downward

B. Caste, Gender and mobility; the death of class

Suggested Readings:

Haralambos, Michael, MartinHolborn and Robin Heald. Sociology: Themes andPerspectives, Collins, 2000.

Gordon,L. „On „Difference", Gender, 1991.

Gupta, D. „Hierarchy and Difference", in Dipankar Gupta (ed.): Social Stratification (1-21), Delhi: OUP, 1991.

Dahrendorf, R. Essays in the Theory of Society, London: Routledge and Kegan Paul, 1968. (Chapter 1)

Beteille, A. „Introduction", in Andre Beteille (ed.): Equality and Inequality: Theory and Practice (1-27), OUP, Delhi, 1983.

Beteille, A. Inequality among Men, Oxford: BasilBlackwell, 1977.

Mencher, J. „The Caste System Upside Down", in Dipankar Gupta (ed.): Social Stratification (93-109), Delhi:OUP, 1991.
Vasanth and Kannabiran K. „Caste and Gender: Understanding Dynamics of Power and Violence", in Anupama Rao (ed.) Gender and Caste (249-60, Delhi: Kali for Women.
Weber, M. 1978. Economy and Society, Berkeley: University of California Press, (Vol. 1, Part-1, Chapter 4:, Vol. 2, Part-2, Chapter 9, Section 6).
Wesolowski, W. 1979. Classes, Strata and Power, London: Routledge and Kegan Paul. (Chapters 1 and 3)
Wright, Olin E. 1985. Classes, London: Verso (Chapter 3)
Marx, K. 1975. The Poverty of Philosophy, Moscow: Progress Publishers (Chapter 2, Section 5).
Miliband, R. 1983. Class, Power and State Power, London: Verso (Chapter 1).
Beteille, A. 1983. The Idea of Natural Inequality and other Essays, Delhi: OUP, pp. 7-32
Sen, A. 1990. „Gender and Cooperative Conflicts", in Irene Tinker (ed.): Persistent Inequalities (123-49), New York: OUP.
Patriwala, R. 2000. „Family: Power Relations and Power Structures", in C. Kramarae and D. Spender 9eds.): International Encyclopedia of Women: Global Women's Issues and Knowledge, vol.2: 669-74), London: Routledge.
Mazumdar, V and Sharma, K. 1990. „Sexual Division of Labour and the Subordination of Women: A Reappraisal from India", in Irene Tinker (ed.): Persistent Inequalities (185-97), New York: OUP.
Chakravarti, U. 1995. „Gender, Caste, and Labour", EPW, 30 (36): 2248-56.
Kapadia, K. 1996. Sive and Her Sisters: Gender, Caste, and Class in Rural South India, Delhi: OUP. (Part 3).
Chowdhry, P. 1997. „Enforcing Cultural Codes: Gender and Violence in Northern India",EPW, 32(19): 10119-28.

PAPER CODE : PGSO3E06

G2P3 : SOCIOLOGY OF SOCIAL EXCLUSION

Unit 1. Understanding the Concept of Social Exclusion:

A. Meaning, definition and nature of social exclusion

B. Western Theories: Marxist - Capitalism and social exclusion, Amartya Sen: Deprivation and social exclusion

Unit 2. Social Categories and Social Exclusion:

A. Caste and social exclusion

B. Gender, patriarchy and social exclusion

C. Ethnicity and social exclusion, with reference to tribes

Unit 3. Socio-Revolutionary Movements and Social Exclusion in India:

A. Mahatma Jyotibha Phule and Savitribai Phule

B. Chhatrapati Shahu Maharaj and Dr. B.R. Ambedkar

C. Periyar Ramasamy,

Unit 4. Social Exclusion and Inclusive Policies in India:

A. Education, natural/ecological resources and weaker sections

B. Privatization and politics of inclusive policies

C. Positive discriminations and social exclusion

D. Empowerment and social exclusion

Suggested Readings:

Ram, Ahuja. Society in India, Rawat Publications, 2004.

Rao, Shankar. Sociology of Indian Society, S. Chand and Company, New Delhi, 2004.

Ghurye, G.S. Caste and Race in India, Popular Prakashan, Bombay, 1969.

Guha, Ranjit. (ed.), Sabaltern Studies: Writings on South Asian History and Society, Oxford, Delhin 1982.

Michael, Haralambos. Sociology:Themes and Perspectives, 13th edition, OUP, Delhi, 1994.

Forbes, G. Women in Modern India, New Delhi: CambridgeUniversity Press, 1998.

Oakley, Ann. Sex, Gender and Society, New York: Harper and Row, 1972.

Malcolm. Globalization, London: Routledge, 1996.

Betelile, Andre. The Backward Classes in Contemporary India, Delhi, OUP, 1992.

Zelliot, Eleanor. From Untouchable to Dalit: Essays on the Ambedkar Movement, New Delhi, Manohar, 1995.

Ambedkar, B.R. The Untouchables: Who were they and why they become untouchables, New Delhi, 1948.-

Rajendra K. Sharma Alantic Publishers and Distributors, New Delhi

PAPER CODE : PGSO3E07

G3P3 : MEDIA AND SOCIETY

Unit 1 : Understanding Media in Society:

A. Mass Media: the concept, definition and forms of mass media

B. Theories of Mass Media: Pluralist, Marxist, Neo-Marxist

Unit 2 : Role and Influences of Media

A. Hypodermic, normative, interpretative and structured interpretative model

B. Hyper reality, interpretative community, violence and media

Unit 3 : Images and Social Group in Media:

A. Representation of gender, caste, class & religion

B. Children, Gender, Sexuality and Media Effect

Unit 4 : Media in Globalized World:

A. Media, Market and Popular Culture

B. Capitalist and state ideology in Media

Suggested Readings:

1. Asa Briggs and Peter Burke, A Social History of the Media, Polity Press, Cambridge, 2005.
2. Benjamin, W. The Work of Art in the age of Mechanical Reproduction, Illuminations, New York, Schocken Books, 1969.
3. Williams, R. Communications, Penguin: Harmondsworth, 1962.
4. Hall, S. ‚Cultural studies: two paradigms", Media, Culture and Society, 1980.
5. Herman, Edward S. and Chomsky, Noam. Manufacturing Consent: The Political Economy of Mass Media, Pantheon Books, 1988.
6. John Corner. Dick Pels (eds.), Media and the Restyling of Politics: Consumerism, Celebrity, and Cynicism, London: Sage, 2000.
7. Desai, A.R. The Role of the Press in the Development of Indian Nationalism, in Social Background of Indian Nationalism, Bombay: Popular Prakashan, 1948.
8. Kohli, V. The Indian Media Business, London: Sage, 2003.
9. Jeffrey, Robbin. India"s Newspaper Revolution. Capitalism, Politics and the Indian language, New York: Martins Press, 2000.
10. Kumar, K.J. Mass Communication in India, Jaico Publishing House, 2010.
11. Gans, H.J. Deciding What"s News, Northwestern University Press, 2004.
12. Appadurai, Arjun. Modernity at Large: The Cultural Dimensions of Globalization, OUP,1996.
13. Sohat, Ella and Robert Stam. Unthinking Eurocentrism: Multiculturalism and the Media, Routledge, 1994.
14. Uberoi, Patricia. Freedom and destiny: gender, family, and popular culture in India, OUP, 2006.
15. Hall, Stuart. "The Whites of their eyes: racist ideologies in the media." In Gail Hymes and Jean M. Hume zeds Gender, race, and class in media: a text reader, Sage, 2003.

16. Said, Edward. Covering Islam: How the Media and Experts Determine How We See the Rest of the World, New York; Pantheon, 1981.
17. C. Berry and F. Martin. (eds.). Mobile Cultures: New Media in Qeer Asia, Duke University press, 2003.
18. Khan, R. and D. Keller. "New Media and Internet Activism: From the "Battle of Seattle to Blogging." New Media and Society, 2004.

PAPER CODE : PGSO3E08

G4P3 : ENVIRONMENT AND SOCIETY

Unit 1: Environment and human ecology

A. Diverse forms of Social and Cultural Ecology

B. Technological change, Agriculture and Biodiversity.

C. Environmental pollution, Public Health and Disability.

Unit 2: Ecology and Human response

A. Ecological degradation and migration

B. Development, displacement and rehabilitation.

C. Disaster and community response

Unit 3: Environment and Indigenous people.

A. Indigenous knowledge system and ethno-medicine

B. Forest policies, Adivasis and exclusion

C. Climate change, epidemics and international policies.

Unit 4. Unequal distribution of resources.

A. Gender and environment.

B. Water and social exclusion.

C. Environmental movements.

Suggested Reading

Macionis & Ken Plummer, *Sociology: Global Introduction*, 5th Ed. Pearson

Haralambos M., *Sociology: Themes and Perspective*, 8th Ed., Harper Collins Publishers Limited, 2013.

Giddens A. & Sutton P. W., *Sociology*, 7th ed., Wiley, 2013.

Ahuja Ram, *Social Problems in India*, 5th ed., Rawat Publication.

Veena Das, ed., Sociology and Social Anthropology, Vol. 1 & 2, Oxford, India, 2003.

Sen Amartya and Dreze Jean, Indian Development: Selected Regional Perspectives, Oxford, 2010.

Banerjee Debdas, Globalisation, Industrial Restructuring and Labour Standards: Where India Meet the Global, 2005, Sage India.

Sikdar Soumyen, Contemporery Issues in Globalisation: An Introduction to Theory and policy in India, Oxford India, 2003.

Sklair Leslie, Globalisation: Capitalism and its Alternatives, 3rd ed., Oxford, 2002.

Bhagwati Jagdish, In Defence of Globalisation, Oxford India, 2004.

Bhalla Surjit S., Imagine There's No Country: Poverty, Inequality and Growth in the Era of Globalisation, Penguin India, 2003.

Bhattacharya Malini, Globalisation: perspectives in Women's Studies, Tulika Books, 2004.

D'Souza Rohan, ed., Environment, Technology and Development: Critical Subversive Essays, Orient Black Swan, 2012.

Newton Tim, Nature and Sociology, Orient Black Swan, 2012.

Hannigan John, Environmental Sociology, 2nd ed., Manohar Publishers & Distributors, 2008.

MANDATORY RP

Important Note: Mandatory RP Course (i.e. Research Project) is continuous process which start at third semester and end in fourth semester with same topic. The research methodology adopted in this process is same which opt in first semester of this course. The first part (which describe in course syllabus) should be completed and evaluated in third semester only and end part of this project should be submitted and evaluated in fourth semester only.

PAPER CODE : PGSO3M09

RESEARCH PROJECT

Student should submit a report of 50 - 60 pages to University which content the following topics.

1. **Introduction**
   A. Sociological Theory related to Topic (should cover concept / variables which are focused in topic, theory / theories related to concept/s i.e. Variables)
   B. Introduction of respondents / population / stake-holders (which are the subjects of research)
   C. Geographic area (which are involve in field survey)
   D. References ; APA referencing should be follow writing

2. **Review of Literature** (should follow the standard procedure)
   A. Categorization of Review of Literature (according to topic and subjects i.e. stake-holders) (nearby 20)
      Regional level context / National level context / International level/context
   B. Significance of the study
   C. Research Gap
   D. Statement of Problem
   E. Relevance of Study

F. References; APA referencing should be follow at the time of writing

3. **Research Methodology** (the subtopics of methodology should be framed according to quantitative / qualitative methods which used for study)
   A. Universe and field of study
   B. Research Design
   C. Research questions (for qualitative study)
   D. Objectives (maximum four)
   E. Hypothesis (for quantitative study)
   F. Sample design of research, techniques of data collection (field work)
   G. References ; APA referencing should be follow writing

4. **Bibliography**

Suggested Readings:

The students shall have to refer to the selected reading materials suggested for the papers on Quantitative and Qualitative Methods in Social Research as they opt in Semester- I

SEMESTER: IV

MANDATORY PAPERS

PAPER CODE : PGSO4M01

POSTMODERN SOCIAL THEORIES

Unit 1 : Early Theorizing of Post-modernity

A. Jean Francois Lyotard : Language game, knowledge in Computerised society

B. Zygmunt Bauman : Society of Consumers, Morality & Violence

Unit 2 : Structure in Complex Society - I

A. Pierre Bourdieu : Capitals - Construction of Habitus and Field

B. Jürgen Habermas : Colonialization of Life World

Unit 3: Structure in complex Society - II

A. Ulrich Beck : Risk Society, Democratization of Science

B. Anthony Giddens : Globalization and de-traditionalization

Unit 4 : Post Modern theories

A. Jean Baudrillard : Symbolic Exchange, Hyper-reality

B. Fredric Jameson : Cultural Logic of Late Capitalism, Commodity Culture and Consumer Society

Suggested Reading

1. Braaten, Jane. 1991. *Habermas's Critical Theory of Society*. Albany: State University of New York Press.
2. Alexander, Jeffrey C, 1987, Twenty Lectures: Sociological Theory since World War II, New York, ColumbiaUniversity Press.
3. Craib, Ian, 1992, Modern Social Theory: From Parsons to Habermas (2nd edition), London, Harvester Press.
4. Collins Randall, 1997 (Indian edition), Sociological Theory, Jaipur and New Delhi, Rawat Publications.
5. Giddens Anthony, 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
6. Kuper Adam and Jessica Kuper (ed.), The Social Science Encyclopedia, London and New York, Routledge.
7. Ritzer George, 1992, Sociological Theory, New York, McGraw-Hill.
8. Sturrock John, (ed.), 1979, Structuralism and since: From Levi-Strauss to Derida, Oxford, OUP.
9. John Rex, Key Problems of Sociological Theory, Routledge, London.
10. Turner, Jonathan H., 1995, The Structure of Sociological Theory, Jaipur and New Delhi, Rawat Publications.
11. Zeitlin, Irving M., 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur and New Delhi, Rawat Publications.
12. Skidmore William, Theoretical Thinking in Sociology, CambridgeUniversity Press.
13. Narendra Kumar Sindhi, 1998, Samajsashtriya Sidhanta: Vivechan abam Bakhya, Rawat Publications (in Hindi).
14. S.L. Doshi, and M.S. Trivedi, 1996, Uttar Samajsashtriya Sidhanta, Rawat Publications.

PAPER CODE : PGSO4M0Z

RECENT TRENDS IN SOCIAL THEORIES

Unit 1 : Cultural Theories

A. Gayatri Spivak and the Subaltern, Slavoj Zizek - Strategic essentialism and Subaltern

B. Edward said - Culture and Imperialism Paul Virilio and Hypermodernism

Unit 2 : Theories of Globalization

A. George Ritzer: Hyperrationality, McDonaldization and Americanization

B. Ernesto Laclau and Chantal Mouffe - Hegemony and Radical Democracy

Unit 2 : Information and Network Theories

A. Manuel Castells: Theory of Network Society.

B. Donna Haraway: Theory of Cyborg, Tentacular Thinking: Anthropocene, Capitalocene, Chthulucene.

Unit 4 : Theories of Future / Digital Society

A. Paul Levinson : Society in Cyber Space

B. Ori Schwarz: The digital objectification of social life

Suggested Reading

August, V. (2022). Network concepts in social theory: Foucault and cybernetics. *European Journal of Social Theory, 25*(2), 271-291.

Bell, W. (1996). The Sociology of the Future and the Future of Sociology. Sociological Perspectives, 39(1), 39-57. https://doi.org/10.2307/1389342

Calhoun, C., Gerteis, J., Moody, J., Pfaff, S., & Virk, I. (Eds.). (2012). *Contemporary sociological theory*. John Wiley & Sons.

Deborah Eade (Ed.). 2002. Development and Culture: Selected Essays from Development in Practice. Oxford: Oxfam GB in association with World Faiths Development Dialogue

Fuchs, C. (2007). *Internet and society: Social theory in the information age* (Vol. 9). Routledge.

Gary Alan Fine, Tiny Publics: A Theory of Group Action and Culture (New York: Russell Sage, 2012).

Jayapalan, N. (2014). *Sociological Theories*. New Delhi: Atlantic Publishers & Distributors (P) LTD.

Lawrence Harrison and Samuel Huntington (Eds.). 2001. Culture Matters: How Values Shape Human Progress. New York: Basic Books.

Mannheim, K. (1952). The Problem of Generations. In P. Kecskemeti (Ed.), Essays on the Sociology of Knowledge (pp. 276-320). London: Routledge and Kegan Paul.

Ori Schwarz 2021. Sociological Theory for Digital Society: The Codes that Bind Us Together. Publisher: Polity ISBN: 9781509542970

Singer, J. A., & Salovey, P. (1988). Mood and memory: Evaluating the Network Theory of Affect. *Clinical Psychology Review, 8*(2), 211-251. https://doi.org/10.1016/0272-7358(88)90060-8
Ziauddin Sardar. 2004. Introducing Cultural Studies. Cambridge: Icon Books Ltd.
Paul Levinson, Digital Macluhan, Routledge, New York, 1999

PAPER CODE : PGSO4M03

ECONOMY AND SOCIETY

Unit 1. Concepts and Debates

A. Concepts: Exchange, Gift, capital, Labour, Market, Consumption

B. Digital economy, E-commerce

C. Mode of production debates - Socialist, Capitalist and neo-liberal

Unit 2. Property relations and Social setting.

A. Property and property relations in family and society

B. Property and exclusion (Socio-Political) and

C. Business and family - in Traditional and Neo-liberal society.

Unit 3. State and emerging trends in the age of neo-liberalisation

A. State and Market: Welfare-ism and Neoliberalism

B. Models of economic development

C. Global business and Corporates

D. Tourism - Immerging trends and Indian condition.

Unit 4. Labour in the era of neo-liberalism.

A. Factory and industry system - in liberal and neo-liberal era.

B. Changing nature of labour relations in global market of labour.

C. Gender and labour relations - prospects and exploitation

Bibliography

Macionis & Ken Plummer, *Sociology: Global Introduction*, 5th Ed. Pearson

Haralambos M., *Sociology: Themes and Perspective*, 8th Ed., Harper Collins Publishers Limited, 2013.

Giddens A. & Sutton P. W., *Sociology*, 7th ed., Wiley, 2013.

Ahuja Ram, *Social Problems in India*, 5th ed., Rawat Publication.

Veena Das, ed., Sociology and Social Anthropology, Vol. 1 & 2, Oxford, India, 2003.

Sen Amartya and Dreze Jean, Indian Development: Selected Regional Perspectives, Oxford, 2010.

Balkrishnan Pulapre, ed., *Economic Reforms and growth in India*, Orient Black Swan, 2012.

Tonkiss Fran, Contemporary Economic Sociology: Globalisation, Production & Inequality, Manohar Publishers & Distributors, 2006.

Banerjee Debdas, Globalisation, Industrial Restructuring and Labour Standards: Where India Meet the Global, 2005, Sage India.

Sikdar Soumyen, Contemporery Issues in Globalisation: An Introduction to Theory and policy in India, Oxford India, 2003.

Sklair Leslie, Globalisation: Capitalism and its Alternatives, 3rd ed., Oxford, 2002.

Bhagwati Jagdish, In Defence of Globalisation, Oxford India, 2004.

Bhalla Surjit S., Imagine There's No Country: Poverty, Inequality and Growth in the Era of Globalization, Penguin India, 2003.

Bhattacharya Malini, Globalization: perspectives in Women's Studies, Tulika Books, 2004.

ELECTIVE COURSES

Important Note : Continue your elective's group in second seminar. For example, if you opt G1P1 in first semester, then opt G1P2 in second and G1P3 in third. As well, avail G1P4 in fourth semester. It is equally applicable to all four groups.

PAPER CODE : PGSO4E04

G1P4 : SOCIOLOGY OF MARGINALIZED COMMUNITIES

Unit 1. Understanding Marginalized Communities and the Bases of Marginalization

A. The meaning and definition of marginalized communities

B. Bases of marginalization: socio-economic and political, discrimination, deprivation, exploitation, segregation and poverty

Unit 2. Theories of Marginalizati

A. Caste theory of marginalization

B. Racial theory of marginalization

C. Religious and cultural theory of marginalization

D. Economic (Marxist) theory of marginalization

Unit 3. Marginalized Communities in India:

A. SCs, STs, OBCs, women and minorities

B. Socio-economic status, mobility and problems among the marginalized communities

Unit 4. Means of Eradicating the Situation of Marginality:

A. Education, employment and political participation

B. Access to health and civic amenities

C. Socio-cultural assimilation and absorption

Suggested Readings:

1. Ahuja, Ram. Indian Social System, Rawat Publications, Jaipur, 1993/2002.
2. Beteille, Andre. Backward Classes and the New Social Order, OUP, Delhi, 1981.
3. Beteille, Andre. The Backward Classes in Contemporary India, OUP, Delhi, 1992.Charsley, S.R. and G.K. Karanth (Eds.), Challenging Untouchability, Sage Publications, Delhi, 1998.
4. Chaudhuri, S.N. Changing status of depressed castes in contemporary India, Daya Publishing House, Delhi, 1988.

5. Gore, M.S. The Social Context of an Ideology: The Social and Political Thoughts of Babasaheb Ambedkar, Sage, New Delhi, 1993.
6. Gupta, Dipankar. Social Stratification, OUP, New Delhi, 1991.
7. Jogdand, P.G. New Economic Policy and Dalits (Jaipur: Rawat)2000.
8. Jogdand, P.G. Dalit Movement in Maharashtra, Kanak Publications, New Delhi, 1991.
9. Mane Suresh. Glimpses of Socio-Cultural Revolts in India, Samrudh Bharat, Mumbai, 2006.
10. Omvedt, Gail. Dalit Visions: The anti-caste movement and the construction of an Indian identity, Orient longman, New Delhi, 1995.
11. Omvedt, Gail. Dalits and the Democratic Revolution, Sage, New Delhi, 1999.
12. Oommen,T.K. Protest and Change: Studies in Social Movements, Sage, Delhi, 1990.
13. Shah, Ghansham. Social Movements in India: A Review of Literature, Sage, Delhi, 1990.
14. Singh, K.S. The Scheduled Castes, Anthropological Survey of India, Delhi, 1998.
15. Singh, K.S. The Scheduled Tribes, OUP, Delhi, 1995.
16. Thorat, Sukhadeo. New Economic Policy and its Impact on Employment and Poverty of the Scheduled Castes, 1997, (PuneUniversity).
17. Zelliot, Eleanor. From Untouchable to Dalit: Essays on the Ambedkar Movement, Manohar, New Delhi, 1995.
18. Venugopal, C.N. Ideology and Society in India: Sociological Essays, Criterion Publications, New Delhi, 1988.

PAPER CODE : PGSO4E05

G2P4 : SCIENCE, TECHNOLOGY AND SOCIETY

Unit 1 : History of Technological Development

A. Meaning of Science and Technology. Science and Technology - from Past to Present

B. Changing notions of Time and Space - physical to virtual. Flows/currents in S&T, Boundaries of S&T

Unit II : Science, Technology and Society

A. Virtual Community - meaning, relations with digitalization of life-world, Media - print, electronics, visual and social

B. Technology and Changing family relations, changing food habits and changing health system

Unit III : Science, Technology and State

A. E-Governance and Surveillance of Society - Aadhar, PAN Card, etc. linking. Emerging Political Processes - media socialization, opinion generation, controlling media, fake news, IT Cells, etc.

B. State Policy - E-Centric governance, digital and non-digital population, digitally excluded and included population

Unit IV : Science, Technology and Cyber Crime

A. Crime against Person - hacking of sites, mails, apps, etc. Selling personal data. Financial crime. Intrusion in digital gazettes, morphing, crime against women

B. Crime against Society: viral rumors or fake news, data theft, pornography, etc.

Suggested Reading

1. Who controls the Internet: Illusions of Borderless World, Jack Goldsmith and Tim Wu, OUP, 2006,
2. Sociology in the age of the Internet, Allison Cavanagh, McGrawhill & Open University Press, New York, 2007
3. Internet and Social Inevalities, James C. Witte and Susan E. Mannon, Routledge, New York, 2010
4. Globaliation: the Basic Text, George Ritzer, Wiley-Blackwell, 2010
5. After Habermas: New Perspectives on the Public Sphere, N.Crosssley and J.M. Roberts, Blackwell Pub. 2010

6. Information Technology and Development, Jeffrey James, Routledge, London, 2004
7. Cyberprotest: New Media, Citizens and Social Movements, W.V. DeDonk, B.D. Loader and others, Routledge, London, 2004
8. News Culture, Stuart Allan, Open University Press, Berkshire, 2004

PAPER CODE : PGSO4E06

G3P4 : CULTURE AND SYMBOLIC TRANSFORMATION

Unit I : Cultural Studies

A. Meaning and elements of Culture - Cognitive Elements, Beliefs & Practices, Signs & Symbols, Norms and Values

B. Material and Non-material Culture - Cultural lag, Civilization and Culture, Technology and Changing Material Culture

Unit II : Culture and Religion

A. Religious Economy : Economy of Religious Culture, Pilgrimage and Religious Tourism, Commodification of Rituals

B. Culture of Religion : Religious Organizations, New Religious Movements, Piety and Spirituality, Moral Economy

Unit III : Politics of Culture

A. Cultural Politics : Communalism and Secularism, Politics of Culture, Culture in Politics

B. Cultural Identity and Mobilization. Culture in Ethics and Morality. Culture of Gender and Body

Unit IV : Cultural Trends

A. Formal and informal Education as a conductor and producer of culture. Arts and Aesthetics

B. Sports and Culture, Culture and Environment

Suggested Readings

1. Jim McGuigan, 2014 Rethinking Cultural Policies, Open University Press, Berkshire.
2. M.G. Durham and Douglas M. Kellner 2006 Media and Cultural Studies, Blackwell Pub. Malden.
3. James Curran and David Morley, 2006 Media and Cultural Theory, Routledge, London.
3. John Haiman, 1998 Talk is Cheap: Sarcasm, Alienation and Evolution of Language, OUP.
4. Melissa Gregg, 2006 Cultural Studies' Affective Voices, Palgrave, Hampshire.
5. Angela McRobbie 2005 The Uses of Cultural Studies, , Sage, London.
6. Francis Mulhern 2000 Culture/Metaculture, Routledge, New York.
7. Chris Jenks 1993 Culture, Routledge, London.

PAPER CODE : PGSO4E07

G4P4 : STATE, POLITICS AND DEVELOPMENT

Unit I: Development of Polity

A. From Tribe to Nation-State - Concepts of Ancient Republics, City-State, State, Nation-State. From Chieftainship to Grass-root Democracy. Nature of Distribution of Political Powers and Authorities

B. Development of Governance: Bureaucracy, Governance and Development of Society, Development and Relationship of Law and Society. Corruption

Unit II: Politics and Issues of Society

A. Development of Political Culture - the Role of Media, Social Media, Political Parties and Political Processes. Role of International Development Organization in Local Politics.

B. Public Policy and State: Health, Education, Livelihood and Gender-based Development.

Unit III: State and Interest Politics

A. Interest Politics: Interest, Ideology and Political Fractions. Interest and Pressure Group Politics.

B. Reservation: as share in Power and Authorities, Politics in Reservation, Politics for Reservation, Politics of Reservation.

Unit IV: Social Movements and Protest

A. Movements : Types of Movements. Movements and Rights & Redistribution of Powers. Bases of Movements - Caste, Ethnicity, Ideology, Disability, Religion and Region.

B. Democracy and Civil Society : Concept, Meaning and Importance of Civil Society, The issue of Citizenship and Civil Society. Role of NGOs and Leadership in Power Politics,Concept of Activism and its role in Protest Movements.

Suggested Reading

1. Social Justice and Enlightment, Pradeep Kumar Bose & Samir Kumar Das, Sage, New Delhi, 2009
2. Human Rights and Social Justice in a Global Perspectives, Susan C. Mapp, OUP, 2008
3.Gender and Justice in Multicultural Liberal States, Monique Deveaux, OUP, 2006

4. The Modern State, Christopher Pierson, Routledge, London, 1996
5. State and Society, J. Gledhill, Barbara Bender and Others, Routledge, London, 1988
6. The Blackwell Companion of Social Movements, D.A. Snow and Others, Blackwell, Oxford, 2006
7. Dispersing Power: Social Movements as Anti-Sate Forces, Raul Zibechi, AK Press, Oakland, 2010
8. Social Movements: Identity, Culture and the State, D.S. Meyer, Nancy Whittier and others, OUP, 2002
9. The Globalization of Corporate Media Hegemony, Lee Artz and Yahya Kamalipour, State University of New York state, Albany, 2003

MANDATORY RP

Important Note: Mandatory RP Course (i.e. Research Project) is continuous process which start at third semester and end in fourth semester with same topic. The research methodology adopted in this process is same which opt in first semester of this course. The first part (which describe in course syllabus) should be completed and evaluated in third semester only and end part of this project should be submitted and evaluated in fourth semester only.

PAPER CODE : PGSO4M08

RESEARCH PROJECT

Student should submit a report in 100-110 pages to University which content the following topics infollowing format to be followed in preparing Research Paper - II after field study as per research topic sanctioned in semester III for Research Paper - I

1. Socio-economic Background of Respondents
   (it should content the age, income, caste, class, religion, etc. as per requirement of research topic)
   While interoperation of data, relevant theories or references should be used in body text.
2. Chapters related to Objectives (maximum four chapters)
   Chapters should be separately formulated according to objectives of study
   While interoperation of data, relevant theories or references should be used in body text.
3. Final Chapter (Conclusion / summery and suggestions)
4. appendix
   A. Tables
   B. Graphs
   C. Interview schedule / questionnaire / Interview Guide
   D. Bibliography

Suggested Readings:

The students shall have to refer to the selected reading materials suggested for the papers on Quantitative and Qualitative Methods in Social Research in Semester- I

STRUCTURE AND CREDIT DISTRIBUTION OF POST GRADUATE DEGREE PROGRAM

M.A Economics (All Affiliated College)

From the Academic Session 2023-24

PG Diploma after 3 Years Degree

Year	Level	Semester (2 Years)	Major			RM	OJT/FP	RP	Cumulative Credit
			Mandatory	Credit	Electives (Choose Any One)				
	6.0	Semester - I	1. Micro-Economic Theory – I 2. Macro-Economic Theory – I 3. Statistics for Economics 4. Maharashtra Economy	4 4 4 2	1. Agricultural Economics 2. Industrial Economics 3. Mathematics for Economics	Research Methodology	-	-	22
			Credit	**14**	**4**	**4**	**-**	**-**	**22**
		Semester - II	1. Micro-Economic Theory – II 2. Macro-Economic Theory– II 3. Economics of Micro-Finance 4. Economics of Industrial Organization	4 4 4 2	1. Applied Econometrics 2. Labour Economics 3. Political Economy	-	On Job Training/Apprenticeship or Field Projects	-	22
			Credit	**14**	**4**	**-**	**4**	**-**	**22**
			Cumulative Credit for PG Diploma	**28**	**8**	**4**	**4**	**-**	**44**
Exit Option : PG Diploma (44 Credits) after 3 years UG Degree									

Year	Level	Semester (2 Years)	Major			RM	OJT/FP	RP	Cumulative Credit
			Mandatory	Credit	Electives (Choose Any One)				
	6.0	Semester - III	1. Economics of Development & Growth - I 2. International Trade – Theory & Policy 3. Economics of Money & Banking 4. Economics of Sustainable Development	4 4 4 2	1. Indian Public Finance 2. Indian Economy – Issues & Policies 3. Economics of Environment	-	-	Research Project	22
			Credit	**14**	**4**	-	-	**4**	**22**
		Semester - IV	1. Economics of Development & Growth - II 2. International Trade & Investment 3. Urban & Rural Economy	4 4 4	1. Entrepreneurship Development 2. Energy and Infrastructure Economics 3. Welfare Economics	-		Research Project	22
			Credit	**12**	**4**	-	-	**6**	**22**
			Cumulative Credit for PG Diploma	**26**	**8**	-	-	**10**	**44**
			Cumulative Credit for 2 Year PG Degree	**54**	**16**	**4**	**4**	**10**	**88**
2 Years – 4 Semester (88 Credits) after Three Year UG Degree or 1 Year : Two Semester PG Degree (44 Credits) after Four Year UG Degree									
	8.0		Course Work Course Work Course Work	4 4 4	Training in Teaching/Education/ Pedagogy	4	-	-	Ph.D Work
			Credit	**12**		**4**			**16**

Abbreviations: OJT – On Job Training: Internship/Apprenticeship; FP – Field Projects; RM – Research Methodology; RP - Research Project; Cumulative Credits : Cum.Cr

RTM Nagpur University, Nagpur

New Syllabus as per NEP – 2020

Implementation from the Academic Session 2023-24

Post Graduate Syllabus in Economics

M.A (Part-I) First Semester Examination

(Under Choice Based Credit System/CBCS)

MAJOR - MANDATORY – 1

(Credit – 4)

MICRO-ECONOMIC THEORY – I

Learning Objectives:

1. To provide a good understanding and a base to students in applying the concepts and methods of micro-economics in practical field
2. To equip the students themselves in a comprehensive manner with various aspects of micro-economic theory.
3. To develop the ability to synthesize knowledge

Learning Outcomes:

1. The knowledge of consumer behavior enables the students in recommending rational buying decisions and will also help to suggest firm to design suitable marketing strategies.
2. Students get equipped with knowledge and skill in suggesting effective decisions under uncertain market situations
3. Students understand the importance of time application and household management
4. The students will develop the skill for converting technical information into economic relationship between input and output
5. The students will develop skill to identify homogeneity level in production function and be able to estimate production function and shall be able to estimate level of output.
6. The course will help students to give recommendations on allocation of quantities of different factors of production to achieve economies of production and use of learning curves
7. The students will learn about maintain existence of firm in markets and shall be able to recommend to earn profit.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Advances in the theory of Consumer Behavior** - Derivation of demand curve by using of indifference curve approach and revealed preference approach- Hicksian Revision of demand theory, modern utility analysis of choices involving risk and uncertainty-Bernoulli, Neuman-Morgenstern, Friedman-savage, Hypothesis
2	**Theory of Production and Cost** – Relation between return to factor and return to scale – multi product firm- production function-Cobb-Douglas, CES, VES; technical change and production function, Concept of Cost – Derivation of short-run and long-run cost curves- total, average and marginal- economies and diseconomies of scale and cost curves, Modern development in cost theory
3	**Theory of Firm and Price-Output determination in various market structures** – marginal analysis as an approach to price and output determination: Perfect competition – short run and long run equilibrium of firm and industry, monopoly short run and long run equilibrium, price determination, degree of monopoly power, regulation and control of monopoly, Oligopoly – non-collusive oligopoly, kinked demand curve model – collusive Oligopoly – Cartels, mergers, price leadership models, Monopolistic Competition, firm and group equilibrium with product differentiation and selling costs analysis, excess capacity
4	**Advanced approaches to pricing and optimization** – Advanced approaches to pricing and optimization – composite demand and composite supply pricing- Average or full cost pricing – Mark-up pricing, limit pricing - Bains and Silos-Labini model

Books for References:

1. Koutsoyiannis, A. (2005) - Modern Microeconomics, Macmillan press, London
2. Layard, P.R.G. and Walters, A.W. (2001) - Microeconomic Theory, McGraw Hill, London.
3. Sen A(2005). - Microeconomics: Theory and Application, Oxford University Press, New Delhi
4. Stigler, G (2008). - Theory of Price, PHI, New Delhi
5. Varian, H.R.(2005) - Microeconomic Analysis, W.W.Norton, NewYork
6. Mankiw, N.G. (2009), Economics: Principles and Applications, Cengage Learning, India edition
7. Baumol, W.J.(1998): Economic Theory and Operations Analysis, Prentice Hall of India Private Limited
8. Henderson, J.M. & Quandt, and R.E.: Micro Economic Theory, McGraw Hill.
9. Nicholson Walter (2007)- Microeconomic Theory, The Drydon Press, London
10. E.K .Browning and J.M. Browning (2003) - Microeconomics; Theory and Applications, Kalyani Publisher, New Delhi.
11. Maddala, G.S. and Miller, E.: Microeconomics, Theory and Applications; McGraw Hill
12. Pindyck, R.S., Rubinfeld, D.L. & Mehta: Micro Economics, Pearson Education
13. Salvatore. D.: Micro Economics, Theory and Applications, Oxford University Press.
14. Hall Varian: 'Micro Economic Analysis,' Viva
15. Snyder and Nicholson: 'Micro Economics- Basic principles and Extensions' Cengage learning

MAJOR - MANDATORY - 2

(Credit – 4)

MACRO-ECONOMIC THEORY – I

Objectives of the course: -

1. To make students aware of macro – economic models and macro-economic Trends as well as thoughts
2. To deal with international aspects on macro level
3. To critically evaluate the validity of macro models

Learning Objectives of the course: -

1. To demonstrate a good understanding of macro- economic principles, concepts and theories
2. To demonstrate an understanding of implications of Macro-economic decisions and shall be able to form model macro-economic theory
3. To integrate theoretical knowledge to analyse trade-off in deployment of resources to alternate ends and the implications them on society.
4. To make predictions on the happening of different economic things in the different phases of trade cycle and shall be able to derive suggestions.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Macro-economic variables** - General review of classical and Neoclassical economic analysis, systems, Keynesian system – various concepts and measurements of aggregate income and expenditure- Circular flow of four sector model - Rules for computing GDP- Various concepts interpreting GDP
2	**Demand and Supply of Money** – Quality theory of money, Patinkin's views on the relationship between money and prices, Restatement of quantity theory of Money by Milton Friedman – Liquidity approach to money, Radcliffe-Sayers thesis and Gurley – Shaw thesis
3	**Theories of Consumptions and Investment** – Classical of Consumption – The Psychological law of Consumption — Permanent Income Hypothesis – Life Cycle Hypothesis, Normal income Hypothesis, Investment Multiplier, Working and weaknesses **Investment Function** - MEC and rate of interest, Accelerator
4	**Monetary and Fiscal Policies** – Objectives and instrument of monetary policy, Effectiveness of monetary policy during inflation and deflation, Recent changes in monetary policy Fiscal Policy – Objectives and instruments of fiscal policy, Effects of taxation, Public expenditure, Pump priming, Compensatory spending, Public works, Public debt, Problems and limitations of fiscal policy, Monetary and fiscal policy mix, Mundellian Model of internal and external stability

Books for References:

1. Rosalind Levacic and Alexander Rebmann (1982), Macroeconomics: An Introduction to Keynesian Neoclassical Controversies, Macmillan.
2. Errol D'Souza (2008), Macroeconomics, Pearson.
3. David Romer (1996), Advanced Macroeconomics, McGraw-Hill.
4. David, G Pierce and Peter J Tysome (1985), Monetary Economics: theories, evidence and policy, Butter worths.
5. Laidler, D.E.W. (1984), The Buffer Stock Notion in Monetary Economics, Economic Journal 94, 17-34.
6. N. G. Mankiw: Macroeconomics, Pearson.
7. A. B. Abel and B. S. Bernanke: Macroeconomics, Pearson
8. Dorndusch, Fischer and Startz: Macroeconomics, Tata McGraw Hill.
9. Richard T. Froyen: Macroeconomics, Pearson
10. Errol D'Souza: Macroeconomics, Pearson
11. David Romer: Advanced Macroeconomics, 4th edition, McGraw Hill, 2012
12. Sunil Bhaduri: Macroeconomic Theory, New Central Book Agency. 2. Soumyen Sikdar: Principles of Economics, Oxford.

MAJOR - MANDATORY – 3

(Credit – 4)

STATISTICS FOR ECONOMICS

Learning Objectives:

1. To empower the students to master over the technique of classification and analyze data to prove different hypothesis intended to be tested.
2. To provide a tool kit to students to handle massive data and draw inferences from it.
3. To enable the students to interpret the data in nut shell by a averaging, precenting and arranging into different classes through the process of classification
4. To help the student to draw the conclusion in the form of standard deviations, skew nesses and through various co-relations and regressions.
5. To equip the students to represent data in pectoral form and to make it understandable to common masses.

Learning Outcomes:

1. The students will develop the knowledge to interpret the complex statistical tables in graphs given in publish media.
2. The regressions technique shall enable students to predict the future values up to certain time limits.
3. The statistical help in compression and confirm the sample results into population result.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Introduction to Statistics, Data Presentation and Indian Statistics** Statistics in Practice- Application- Data Sources, Descriptive Statistics, Statistical Inference. **Basic Statistical concepts** – Population, Sample, Parameter and Statistics, Variables and Data, **Data Measurement levels-** Nominal, Ordinal, Interval and Ratio, Computer and Statistical Analysis **Construction of Frequency Distribution-** Classification and Tabulation of Data, Graphs and Charts **Indian Statistics:** CSO, NSSO, Recent Population Census, Agricultural and Industrial Statistics
2	**Descriptive Statistics: Numerical Measures** **Measures of Central Tendency:** - Arithmetic Mean, Median, Mode, Geometric, Harmonic Mean, Percentiles and Quartiles **Measure of Variability:** Range, Interquartile Range, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation **Measures of shape** – Skewness
3	**Correlation, Regression Analysis and Index Number** **Correlation Analysis:** Meaning, Importance, Types, Methods of Determining Correlation and Limitations- Karl Pearson's Coefficient of Correlation, Coefficient of Concurrent Deviation, Spearman's Rank Correlation

	Regression Analysis: Meaning, Importance, Types, Methods of Determining Correlation and Limitations- Simple Linear Regression Model, Least Squares Method **Index Number** Time and Factor Reversal Test
4	**Sampling Distributions and Statistical Inference** **Sampling -** Methods of Sampling – Random and Non-random, **Hypothesis Testing–** Meaning, Types, level of Significance, One Tailed and Two Tailed Test, Critical Values and Significant Values. Type I and Type II Errors **Test of Significance** – Small Sample and Large Sample, Chi-Square test and test of 't' test, Analysis of Variance

Books for References:

1. Gupta S.C and Mrs. Indira Gupta: Business Statistics: Himalaya Publishing House; Delhi
2. Gupta, S.C., Fundamentals of Applied Statistics, S. Chand & Sons New Delhi.
3. Gupta, S.P., Introduction to Statistical Methods.,S. Chand& Sons New Delhi.
4. King, W.I.: The Elements of Statistical Methods; The Macmillan Co. New York.
5. Anderson, Sweemey and Villiams, Statistics for Business and Economics, Cengage Learning publication, New Delhi.
6. Elhance, D.N, Practical Problems in Statistics, Kitab Mahal, Allahabad
7. Dr. Gajanan Patil, Fundamental Statistics, Kasturi Publication, Nagpur

MAJOR - MANDATORY - 4

(Credit – 2)

ECONOMY OF MAHARASHTRA

Learning Objectives:

This paper provides a detailed account of various sectors of economy of Maharashtra i.e. natural resources, population, agriculture, industry, infrastructure, fiscal policy and human development. These units will introduce the various challenges faced by the economy of Maharashtra and efforts of the Government to tackle them.

Learning Outcomes:

Students get acquainted with all varied sectors of the economy of Maharashtra. Awareness on challenges to be faced and measures to tackle the challenges

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Features of State Economy** – Geographical structure, administrative set-up, Demographic characteristics, State income, Land, forest, Climate and rainfall, Health, Education, Livestock, Banking, Worker population ratio, Availability of drinking water and sanitation facility, Sector wise real GVA and real GDP, Public distribution system, Beneficiaries under National food security Act - 2013, Deposits and credit of all schedules commercial banks
2	**Sector wise Development in Maharashtra** – Number and area of operational holdings in the state, Area and production of principal crops, Electrification of agricultural pumps, Loan disbursed by various institutions to agriculture, Exports of agricultural produce from State Industrial investment in the state - Industrial units in MIDC, Textile production in the State, Annual survey of industries, No of working factories and employment, Co-operative societies in Maharashtra, Co-operative sugar factories, Progress of health and educational facilities in the state, Transport and communication facilities in the state, Classification of workers as per 2011 Census.

Books for References:

1. Jungale Mangala (2008): Maharashtrachi Arthvyavastha (Marathi), Prashant Publications, 17, Stadium Shopping Centre, Opp. State Bank, Jalgaon –age No. 9 to 19.
2. Kurulkar R. P. (1997): Maharashtrachi Arthvyavastha (Marathi), Vidya Prakashan, Ruikar Marg, Nagpur. Page No. 153 to 179.

3. Munagekar Bhalchandra (2003) :The Economy of Maharashtra – Changing Structure and Emerging Issues, Dr. Ambedkar Institute of Social and Economic Change, Mumbai.

4. Patil J. F. (2010) : Suvarna Mahotsavi Maharashtrachi Badalati Arthvyavastha (Marathi), Abhijit Pratap Pawar, Sakal Papers Ltd., 595, Budhwar Peth, Pune-411002Page No. 41 to 57.

5. Pansare Govind (2012) :Maharashtrachi Arthik Pahani – Paryayi Drushtikon (Marathi), Shramik Pratishthan, Red Plug Bldg.,Bindu Chowk, Kolhapur, Page No. 159 to 195.

6. World Bank (2002) India: Maharashtra Reorienting Govt. to Facilitate Growth and Reduce Poverty.

7. Government of Maharashtra: Economic Survey of Maharashtra, Various Issues.

ELECTIVES – 1

(Credit – 4)

AGRICULTURAL ECONOMICS

Objectives:

1. To provide an understanding to the students about nature and functioning of agrarian economy of India.
2. To enable students to apply economic principles to traditional subsistence agriculture.
3. To equip students to understand process of value generation in agriculture.

Learning Outcomes:

1. The knowledge of nature of Indian Agriculture will enable students to derive suggestions for planning farm operations, for acquiring farm inputs and marketing strategy for selling farm output.
2. It will develop the skills to students for under technical information into economic relation between inputs and output in agriculture.
3. The students will enable to understand the economies of the production and marketing of agricultural products and shall be enable to draw suggestion for practical use.
4. It will help the students to analyse the implication on agricultural policy of government and shall enable them to make practical suggestions for improvement in traditional Indian agriculture.
5. Students are equipped with the knowledge of the emergence of different organizational structures of the farming in India.
6. It will develop the skill in students for analyzing business phenomenon in agriculture in terms of transactions and cost savings.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of each Units

Units No.	Content
1	**Agriculture and the Economy** - Agriculture and economic development – Role of agriculture in Economy, Theories of Agricultural Development – Schultz's views on Transformation of Traditional Agriculture, Lewis, Ranis and Fie models, organizational aspects of farming-Traditional peasant farming, commercial farming, conditions of Indian farmers, farm management
2	**Production function in Agriculture** – Law of variable return and returns to scale in agriculture, rational and Irrational stages in agricultural production function, problem of allocation of resources and least cost combination in agriculture, optimum combination of two products in agriculture Risk and uncertainty in agriculture, WTO and Indian Agriculture- Farm size and agricultural productivity; Mechanization in agriculture; Research and extension in Agriculture, Agricultural technology and green revolution

3	**Marketing of agriculture produce** – Demand and Supply of agricultural products – factors affecting the demand for agricultural products, supply behaviour of agricultural products-Individual and aggregate supply of farm products. Behaviour of agricultural prices-Instability of agricultural prices, agricultural price policy of government, Agricultural Marketing – Approaches to agricultural marketing; problems of agricultural marketing; price spread, marketing margin; marketing efficiency, marketing integration, institutions and organization for agricultural marketing, processing of agricultural products,
4	**Factor Market for Agriculture** –Role of Land, labour and capital in farming, Land Tenancy and efficiency of farming-Land rental contract relationship. Labour market for agriculture – categories of labour, wage good and labour market – Agricultural Credit - characteristics of agricultural, Credit Sources of agricultural credit, Labour in agriculture, Role of land in agriculture, Non-agricultural uses of land

Books for References:

1. Subba Reddy, P.Raghu Ram, T.V. Neelakanta Sastry and I. Bhavani Devi(2008): 'Agricultural Economics' Oxford
2. Sadhu, A.N. & A. Singh: Fundamentals of Agricultural Economics, Himalaya publishing House, Bombay.
3. Soni, R.N.: Leading Issues in Agricultural Economics, Sobhanlal Nagin Chand & Co. Jalandhar
4. Debraj Ray(2012) : 'Development Economics' Oxford India
5. Basu, Kaushik: 'Agrarian Questions' Oxford India 6. Bruch L. Gardner and Gordon C. Rausser : Handbook of Agricultural Economics, North Holland

ELECTIVES – 2

(Credit – 4)

INDUSTRIAL ECONOMICS

Objectives:

1. To make the students aware of new concepts and dynamics in the field of Industries
2. To equip students to understand traditional organizations and modern organization in Industrial establishments
3. To aware students about the process of making investment decisions in Industries.
4. To equip students about industrial locations, finance marketing and pricing
5. To enlighten students about on present Trends in Indian Industrial scenario

Learning Outcomes:

1. The knowledge of Industrial organizations shall enable the students to analyse locational factors of industry and it will enable them to draw suggestions for new proposals of industry.
2. It may promote them to undertake start up schemes on basis local resources and global market. It may enable them to be employment given, rather them employment demanders.
3. The study of industrial financing, accounting and risk analysis will be helpful for students to catch up the opportunities in the field of finance and insurance, where their ample scope for work.
4. Understanding about industrial combination and integration will make them able to analyse public policy and give fruitful suggestions.
5. The students learn about the reasons for existence and expansion of firm and shall be able to analyse efficiency of firms, to offer constructive suggestions.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Industrial Economics and Industrial Organization** - Meaning, scope, need and significance of industrial economics, A new concepts about firm and industry, Business motives- profit maximization, sales maximization, maximization of growth, value maximization and managerial motivations, Industrial Organization- types of industrial organizations, private partnership, company, cooperative and public sector, choice of organizational form.
2	**Industrial location; expansion and efficiency** – Factors affecting industrial location, Theories of Industrial location - Sargant Florence, Weber's Theory, Industrial expansion- Diversification, Vertical integration and mergers, Industrial Efficiency – Productive efficiency and economic efficiency, Future strategy for Industrial growth in India

3	**Industrial Pricing, Investment decisions–** Industrial pricing in practice, Cost-plus pricing, variable cost pricing, Target Rate of Return pricing, group pricing and pricing in public enterprises. **Nature and types of investment decisions-** methods of project evaluation, payback method, NPV and IRR, Social cost benefit analysis, Risk and Uncertainty in Project Appraisal **Industrial Finance** - Need for finance – short term and long term, sources of finance-internal and external, commercial and development banks, Role of foreign capital
4	**Indian Industrial Sector –** Evolution of Indian Industries, Industrial policy in India, small scale Industries, in India, MSME, Industrial sickness, Industrial relations, Private sector industries in India

Books for References:

1. Barthwal, R. "Industrial Economics", Wiley Eastern.
2. Bain, J., "Industrial Organization", John Wiley.
3. Panagariya, A., "India – The Emerging Giant"
4. Sen, A., "Industrial Organisation", Oxford
5. Ahluwalia, I.J. (1985), Industrial Growth in India, Oxford University Press, New Delhi
6. Divine, P.J. and R.M. Jones et. al. (1976), An Introduction to Industrial Economics, George Allen and Unwin Ltd., London
7. Cherunilam, F. (1994), Industrial Economics: Indian Perspective (3rd Edition), Himalaya Publishing House, Mumbai
8. Harndeen, J.B. (1975), The Economics of Corporate Economy, Dunellen Publishers, New York
9. P. Bellaflame and M. Peitz: Industrial Organization and Market Structure 10. Government of India, Economic Survey (Annual)
10. Ahluwalia, I.J. (1985), Industrial Growth in India, Oxford University Press, New Delhi.
11. Brahmananda, P.R. and V.R. Panchamukhi (Eds) (1987), The Development Process of the Indian Economy, Himalaya Publications
12. Barthwal,R.R.(1992), Industrial Economics:An Introductory Text Book, Wiley Eastern Ltd. New Delhi.
13. Cherunilam, F. (1994), Industrial Economics: Indian Perspective, (3rd Edition), Himalaya Publishing House, Mumbai
14. Kuchhal, S.C. (1980), Industrial Economy of India (5th Edition), Chaitanya Publishing House, Allahabad.
15. Reserve Bank of India, Report on Currency and Finance (Annual). And Government of India, Economic Survey (Annual).

ELECTIVES – 3

(Credit – 4)

MATHEMATICS FOR ECONOMICS

Objectives:

1. To make students able to apply methods of mathematics to draw meaningful conclusions from economics data
2. To use mathematical methods to analyse correct economy occurrences
3. To use mathematic techniques for optimization and prediction in economic analysis

Learning Outcomes:

1. The knowledge of mathematical methods will enable students for making the practical suggestions to the optimum consumer and producers' decisions.
2. The students will be able to understand allocation and management of scarce resources.
3. Students will develop the skill to determine homogeneity or non-homogeneity of production function and to estimate the output level for the given input level.
4. Through mathematical predictions, students shall be enabled to find out the cost reduction potential to stand in cur-throat-competitive markets or oligopolistic markets.
5. The knowledge of mathematics shall be useful for students to apply game theory in economic analysis to the markets for obtaining maximum benefits of situation.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Sets, Functions and Basic Functions -** Properties of sets, relations and functions – different forms of functions and graphs- limits and continuity of functions- Basic rules of differentiation, Derivation of implicit functions – and their application in elasticities , costs and revenues, rules of differentiation, partial differentiation, Problem of maxima and minima in single and multivariable functions-application of differentiation in economics rules of integration and their application to economic problems – Derivation of functions from marginal functions
2	**Linear Algebra and Matrices** – Matrices and their applications – Determinants, minors, co-factors and inverse of matrices – Crammers rules- matrices and vectors-Eigen vectors-use in input-output analysis
3	**Differential and Integral Calculus** – Application of partial differentiation in first and higher order partial derivatives – total derivatives – economic application of partial differentiation on elasticity of demand, Homogeneous function, Euler's theorem cobb-dongles and CES Production functions.

	Integral Calculus – Rules of integration, Indefinite and Definite integrals, economic applications, - Integration as total function of economic functions and marginal functions – uses in consumer and producer surplus
4	**Linear Programming and Optimal Control Theory –** Linear Programming – Problem (LLP) and formulation of LPP – Solution of LPP by using graphical and simplex method – duality in LPP- Properties and economic interpretation shadow prices Optimal Control Theory – Calculus of variation and optimal control problem- contrast, state and co-state variables, Hamiltonian – current value and present value, economic application

Books for References:

1. Sydsaeter, Knut and Peter Hammond (2006), Essential Mathematics for Economic Analysis, 2nd Ed. Financial Times, Prentice Hall: Harlow, England.
2. Yamane, Taro (1975), Mathematics for Economists, PHI, New Delhi.
3. Allen, R.G.D. (1974), Mathematical Analysis for Economists, Macmillan Press, New Delhi.
4. Gupta, S.C. (1993), Fundamentals of Applied Statistics., S.Chand, NewDelhi.
5. Chiang, A.C. (1986), Fundamental Methods of Mathematical Economics, McGraw Hill, New York.
6. Handry, A.T. (1999), Operations Research, PHI, New Delhi.

RESEARCH METHODOLOGY

(Credit - 4)

Objectives of the course: -

This course aims at providing the foundation for research methodology. The course is designed to impart basic skills of research and its methodologies. Identify appropriate research topics, review of literature, research gap. Select and define appropriate research problem and parameters. This course also imparts data collection methods, data processing, analysis and interpretation of results. Prepare a project proposal. (To undertake a project) Organize and conduct research (advanced project) in a more appropriate manner. Write a research report and thesis. Prepare a research proposal. (Grants)

Learning Objectives of the course: -

Upon successful completion of this course, students will be able:

1. To help students to develop a thorough understanding of the fundamental theoretical ideas about the research.
2. To help students develop a thorough understanding of the issues involved in research designs and data collection.
3. To help students to understand the importance of sampling methods and analysis of data.
4. To train students in learning how to test hypothesis using computer applications and acquire skills for writing research reports.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Introduction of Research Methodology** Research methodology -meaning, objectives, nature scope and types of research - social- Fundamental, Applied and Action research. Social survey- meaning characteristics, scope, objectives of social survey, steps and types of social research. planning of social survey, merits and demerits of survey. Review of Literature – Meaning, purpose, Style of writing the literature reviews, Citation. Hypothesis -meaning characteristics of good hypothesis, types, importance and limitations. Research design- meaning objectives and types- Applied, Analytical, Exploratory, Descriptive, Diagnostic, Experimental and Case study.
2	**Data Collection methods** Data collection - Primary and Secondary, Sources of primary data - Observation Questionnaire, Schedule, Interview. Merits and demerits of primary data. Sources of secondary data- personal documentary- letters, diary, life history, public documentary sources- published documents, unpublished, documents, Merits and demerits of secondary sources. Merits and demerits of Observation, Schedule, personal interview, mail survey method
3	**Sampling and Data Processing** Meaning of sampling, characteristics of good sampling, merits and demerits of sampling, types of sampling – probability and non-probability, sampling process,

	problems of sampling. Determination of Sample Size. Measurement concept in research, Criterion for good research – Reliability, Validity and Practicality. Data Preparation and preliminary analysis - introduction, validating and editing, coding, data entry, data cleaning and data mining. tabulation.
4	**Hypothesis Testing and Report Writing** Use of statistical techniques for data analysis in research, Mean, Mode, Median, Mean deviation, Standard deviation, Correlation and association. Testing of hypothesis-parametric and non-parametric test. Computer Application, result interpretation, Report writing -objectives, types, content of report, characteristics of good report. Research ethics.

Books for References:

1. Wilkinson and Bhandarkar -Methodology and Techniques of Social research –Pauline, Young-Scientific Social Surveys and Research.
2. Kothari R.C. Research Methodology, Methods and Techniques, New Age International Publishers, IInd revised edition, reprint 2008.
3. Mahore R. Y, Research Methodology, Thakur Publishers, Pune.
4. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
5. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.

RTM Nagpur University, Nagpur
M.A (Economics) First to Fourth Semester Examination
Post-Graduate in Economics Paper Pattern
Implementation Syllabus as per NEP 2023-24
(Under Choice Based Credit System/CBCS as per NEP)

_____Name of Subject

Time: Three Hours} {Maximum Marks:80

Instruction for Candidates:

1. All questions are to be attempted.
2. All questions carry equal marks.
3. Draw neat diagrams wherever necessary.
4. When writing the answer to the sub-questions in the main questions, write the number of themain questions and the sub-question.

Paper Pattern:

1. Answer of the following questions: **(8x2=16)**
   a) Question - From Unit – I **OR** From Unit – I
   b) Question - From Unit – II **OR** From Unit – II

2. Answer of the following questions: **(8x2=16)**
   a) Question - From Unit - III **OR** From Unit – III
   b) Question - From Unit – IV **OR** From Unit – IV

3. Write **ALL** of the following Short Notes: **(4x4=16)**
   a) Question - From Unit - I
   b) Question - From Unit - II
   c) Question - From Unit – III
   d) Question - From Unit - IV

4. Answer **ALL** of the following questions: **(8x2=16)**
   a) Question - From Unit – I
   b) Question - From Unit – I
   c) Question - From Unit – II
   d) Question - From Unit – II
   e) Question - From Unit – III
   f) Question - From Unit – III
   g) Question - From Unit – IV
   h) Question - From Unit – IV

5. Which of the following statements is **Correct or Incorrect with explanation**: (4x4=16)
   a) Draft sentences from Unit -I
   b) Draft sentences from Unit -II
   c) Draft sentences from Unit -III
   d) Draft sentences from Unit -IV

RTM Nagpur University, Nagpur

New Syllabus as per NEP – 2020

Implementation from the Academic Session 2023-24

Post Graduate Syllabus in Economics

M.A (Part-I) Second Semester Examination

(Under Choice Based Credit System/CBCS)

MAJOR - MANDATORY – I

(Credit – 4)

MICRO-ECONOMIC THEORY – II

Learning Objectives:

To Identify the characteristic differences between various market structures, and discuss differences in their operations; Analyze resource markets to understand the decision-making of resource allocation and interrelationships among key markets in the economy. To know through distribution of resources how incomes are earned in the production of goods and services and that the value of the productive factor reflects its contribution to the total product. Welfare economics focuses on the optimal allocation of resources and goods and how the allocation of these resources affects individual and the Society through various theories To understand the role of the government in Economy whenever market fails.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. The students will be familiar with the Various types of markets through their price and cost.
2. They will be able to explain the role of markets and understand how it impacts individuals and the Market.
3. They will be able to understand the distribution of income in society through the theories of Wage determination, Rent, Interest, and Profit.
4. Students will be able to understand why there is a need to have the welfare for society and individuals.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	Pricing of the factors of the Production Ricardian and Modern Theory of Rent, Marginal Productivity Theory of Distribution, Wage Determination under Collective Bargaining, Classical Theory of Interest, Loanable Funds Theory and Liquidity Preference Theory of Interest, Theories of Profit

2	Theories of Distribution Ricardian Theory of Distribution, Marxian Theory of Distribution, Kalecki's Theory of Distribution, Kaldor's Theory of Distribution, Neo-classical Theory of Distribution, Technological Progress and Factor shares in Income
3	**Welfare Economics** Meaning of Welfare Economics, Individual and Social Welfare, Concepts of Social Welfare, Value Judgement in Welfare Economics, Concept and Conditions of Pareto Optimality, Pareto Criterion of Social Welfare, Marginal conditions of Pareto optimum, Amartya Sen's Critique of Pareto Optimality. Perfect Competition and Pareto Optimality, New Welfare Economics, Compensation principle, Kaldor-Hicks Welfare Criterion, Scitovsty's Double Criterion of Welfare, Criticism on Compensation Principle, Public Goods and Market Failure, Theory of Second-Best, Bergson-Samuelson Social Welfare Function. Arrow's Theory of Social Choice, Impossibility Theorem. Amartya Sen on Arrow's Impossibility Theorem, Rawls' Concept of Social Justice and Welfare Criterion
4	**Asymmetric Information and Limit Pricing** Information Problem and Market with Asymmetric Information, Asymmetric Information and Market Failure, problem of Moral Hazard, Spence Model of Signaling, The Principal-Agent Problem, Theory of Limit Pricing- Sylos-Labini Model, Modigliani's Model, Theory of Games– Prisoners' Dilemma

Books for References:

1. Ahuja H. L., (latest version) Advanced Economic Theory: Microeconomics Analysis, 13th Edition, S. Chand and Co. Ltd., New Delhi.
2. Jhingan M. L. (Latest version) Micro Economic Analysis, Vrinda Publications
3. Koutsoyiannis, A.: Modern Microeconomics, 2nd ed., Macmillan Press, London.
4. Baumol, W.J. (1982), Economics Theory and Operations Analysis, Prentice Hall of India, New Delhi.
5. Dewett K. K., (latest version), Modern Economic Theory, S. Chand & Company Ltd., Revised Edition.
6. Kreps, David M (1990): A Course in Microeconomic Theory, Princeton University Press, Princeton.
7. Sen, A. [1999]: Microeconomics: Theory and Applications, Oxford University Press, New Delhi.
8. Stigler, G. (1996): Theory of Price, 4th ed., Prentice Hall of India, New Delhi.
9. Varian, H. (2000): Microeconomic Analysis, W.W. Norton, New York.

MAJOR - MANDATORY – 2

(Credit – 4)

MACRO-ECONOMIC THEORY – II

Learning Objectives:

The course intends to explain the concept of money supply and various theories of demand for money from classical to modern school of thought. The students shall be able to understand the determinants of interest rates and theories of interest rate determination, identify the reasons, types, and effects of inflation and policies used to control inflation. It will also explain business cycles, their theories and measures to control business cycles in an economy.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Components of money supply and approaches to demand money
2. Understand the classical and modern views on interest and policy impact.
3. Use their knowledge to understand and evaluate the impact of inflation and causes business cycles and controlling measures.
4. Use the knowledge of the subject for employment in competitive examinations, banks and financial institutions.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Theories of Employment and Growth** Classical theory of Employment, Keynesian Theory of Employment, Steady Growth, Basic Principles, Models of Steady Growth, Domar Model, Harrod Model, Joan Robinson's Model, Golden Age Model, Solow's Model, Acceleration Principle, Secular Stagnation, Hansen's Thesis
2	**Neo-classical and Keynesian Synthesis** Neo-classical and Keynesian views on interest; The IS-LM model; Extension of IS-LM model with government sector; Relative effectiveness of monetary and fiscal policies; ISLM model in open economy, Monetary approach to balance of payments. Capital flows with fixed exchange rate, trade and capital flows with flexible exchange rate and critical look at IS-LM model
3	**Theory of Inflation** Meaning and Types of Inflation, Demand Pull and Cost Push Theories of Inflation, Inflation and Under developed Economies, Effects of Inflation and deflation, Classical, Keynesian and Monetarist approaches to inflation; Structuralist Theory of Inflation, Measures to control inflation and deflation, Phillips curve, short run and long run Philips Curve, Tobin's modified Philips curve, Quantitative Testing of Inflation
4	**Theories of Business Cycles** Under consumption Theories, Purely Monetary Theory, Monetary Over Investment Theory Non-Monetary Over Investment Theory, Innovation Theory, Mitchell's Theory, The Cob-Web Theory, Theory of Inventory Cycle, Hicks' Theory of Business Cycle. Global Recession, Control of Business Cycles

Books for References:

1. Dornbusch, Fischer, Stratz, Macroeconomics, (Revised Edition), Tata McGraw-Hill. New Delhi
2. Ahuja H. L. Macroeconomics Theory and Policy, S. Chand and Co. Ltd New Delhi.
3. Mankiw, N. G. Macroeconomics, (Revised Edition), Worth Publications. New York. Blackhouse.
4. R. and A. Salansi (Eds.) (2000), Macroeconomics and the Real World (2 Vols), Oxford University Press, London.
5. D'Souza, Errol (2009), Macroeconomics, Pearson Education, Delhi.
6. Gupta R.D. and Rana A.S. (1998): Post-Keynesian Economics, Kalyani Publishers, Ludhiana.
7. Jhingan, M.L.(2020) : Macro Economics, Vrunda Publications, New Delhi.
8. Keynes, J.M (1936). General Theory of Employment, Interest and Money.
9. Gupta, R. D. (1982), "Keynes and Post Keynesian Economics," Kalyani Publishers, Ludhiana.
10. Mithani D. M., (2020), Money, Banking, International trade and public finance, Himalaya Publications, Nagpur.
11. Rakshit, M. (1998), Studies in the Macroeconomics of Developing Countries, Oxford University Press, New Delhi.
12. Rana and Verma, (2016), Macro Economic Analysis, 11th edition, Vishal Publication Jalandhar, Delhi.
13. डॉ. रामदास माहोरे (2018), व्यापार चक्राचे सिध्दांत, साई ज्योती प्रकाशन

MAJOR - MANDATORY – 3

(Credit – 4)

ECONOMICS OF MICRO-FIANCE

Learning Objectives:

To equip the students themselves in compressive manner with various aspects of micro finance activities to be undertaken by banks. To help the students in understanding traditional methods of financing micro enterprises under MSME in India To understand the effects of micro finance on process of disbursing and recovering the loans through social pressure of SHGS

Learning Outcomes:

1. Basics of micro-finance and various activities conducted through various schemes and institutions in India.
2. Role of NBFCs for the development of microfinance.
3. Regulatory measures used for the development of microfinance.
4. Financial and social performance of microfinance and important institutions of microfinance in India

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Micro-finance- Role and Problems** Micro-finance origin, definition, Types, Objectives, Features, Principles, Benefits and Criticisms, Micro-finance Institutions and their types, Micro Finance Companies in India, Challenges faced by micro-finance institutions Self Help Group and Micro Finance, government schemes for self-help groups in India, Deendayal Antyodaya Yojana, National Livelihood mission, and poverty Alleviation Programmes, Importance of SHGs, Benefits to Members, Women, Banks, Government, Voluntary Agencies and Society, Microfinance and Women Empowerment
2	**Financial Planning of MFIs** Financial Management of MFIs, Credit risk, types of credit risk, Integrated risk management, Non-banking financial companies and micro-finance, Types of NBFCs, Non-banking Financial Companies in India Difference between Bank finance and microfinance, Development in the Microfinance sector, Concerns in the microfinance sector related to consumer protection
3	**Regulatory approaches towards Microfinance** Need to review the current regulatory framework, Microfinance credit lending models, participatory rural approach concepts and prerequisites, Conducting Participatory Assessment, Tools and techniques of Participatory Assessment. Microfinance release protection and guarantee program, Role of Asian Development Bank, Role of Foreign Financial Institutions in Microfinance
4	**Financial and Social Evaluation** Financial rating, measurement of indicators and financial performance analysis, Social performance management definition and principles, social performance analysis, NABARD and microfinance, Role of major banks and financial institution in Microfinance Impact of Microfinance on people and societies, the status of Microfinance in India, Critical study of Microfinance in India, Top Microfinance institutions in India.

Books for References:

1. Rotherford Stuart, (2000), 'The Poor and their Money," Oxford University Press, Delhi.
2. Yunus Muhammad, (2008) 'Creating a World Without Poverty: Social Business and the Future of Capitalism, Public Affairs, New York.
3. Patil R. M., (2011) 'Impact of Microfinance through Self-Help Groups,' Discovery Publishing Pvt. Ltd Delhi
4. Shrinivasan, N. (2010), 'Micro Finance in India: State of the Sector Report 2010,' Sage Publication, New Delhi
5. Watkins Todd A., (2020) 'Introduction to Microfinance', World Scientific Publisher, Chennai
6. Das Puspita, (2014) 'Empowerment and Microfinance ', Biotech Publisher.
7. V. Rengarajan, (2013), 'Microfinance Principles and Approaches' Notion Publication

MAJOR - MANDATORY – 4

(Credit – 2)

ECONOMICS OF INDUSTRIAL ORGANISATION

Learning Objectives:

This paper will make aware learners about the factors helping industry organization, other areas support it, market structure, also to focus on financial institutions, public policies and theories of location. It also focuses on aspects related to industrial growth.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Develops students' understanding of the historical background of industrial development, industrialization and antitrust Law.
2. Have a knowledge of various concepts of market power and business strategies.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of Each Units

Units No.	Content
1	**Introduction** Industrial Organization – Meaning, Objectives, types and Functions, Demand and Supply for Industrial Organization, Different Approaches of the study of Industrial Organizations, Macro Economic Models, Public Policy related to Economic Regulation and Antitrust Law, Colluslon – Signaling, Mergers and Acquisitions, Industrial Policy
2	**Market Power** Market Power and Product Quality, Product Differentiation, Price Discrimination, Durable Goods and Experience Goods, Business Strategies and Strategic Behaviour - Meaning, Principles and Applications, Secondary Markets and their relationship with Primary Markets, Examples of Industrial Organizations.

Books for References:

1. Luis M. B. Cabral (2017), 'Introduction to Industrial Organization, 2nd ed., The MIT Press.
2. Jean Tirole (1988), 'The Theory of Industrial Organization', Cambridge, The MIT Press.
3. Bain J. S. (1959), 'Industrial Organization', 2nd ed. New York, Wiley.
4. Bresnahan, T. F. (1959), 'Empirical Studies of Industries with Market Power in Handbook of Industrial Organization', Vol. 2 e. R. Schmalensee and R. D. Wing, Amsterdam, North Holland.
5. Paul Belle Flamme and Martin Peitz (2015), 'Industrial Organization, Markets and Strategies', 2nd ed., Cambridge University Peress.
6. Basu, S. K., K. C. Basu, B. Rajiv, (2012), 'Industrial Organization and Management', Prentice Hall India Learning Private Ltd.
7. Barthwal R. R. (2007), 'Industrial Economics: An Introductory Text Bouk', New Age International Pub.
8. Lynne Pepall (1998), 'Industrial Organization Contemporary Theory and Practice', South Western.
9. Don E. Waldman, Elizabeth J. Jensen (2019), 'Industrial Organization: Theory and Practice', 5th ed., Routledge.
10. William G. Shepherd, Joanna M. Shepherd (2003), 'Economics .of Industrial Organization', Waveland Press, Inc.

ELECTIVES – 1

(Credit – 4)

APPLIED ECONOMETRICS

Objectives:

The basic objective of the course is to provide knowledge on Econometric applications of Economic theory. This course is designed to define meaning of Econometrics, steps in Empirical Economic Analysis, Different types of data involved in Econometric Analysis. The course involved Simple and Multiple Linear regression model. Basic concept of dummy variable model which will be helpful for future research work with qualitative data. The course also focused on the application of simultaneous equation model and Time Series analysis

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1) Students will have adequate competency in the areas of economic theory and methods

2) Use basic econometric estimation techniques such as Ordinary Least Squares to estimate single and general regression models.

3) Impacts for the violation of the important assumptions for the application of OLS regression.

4) Students will acquire applications of dummy variable techniques and estimation of the dummy variable model.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of each Units

Units No.	Content
1	**Basic Econometrics** Econometrics- Meaning, Nature, Scope, Importance. Methodology of Econometrics, Structure of Economic Data, Simple and General linear regression model – Assumptions, Estimation (through OLS approach) and properties of estimators; Gauss-Markov theorem; Concepts and derivation of R-square and adjusted R- square
2	**Problems in Regression Analysis and Dummy Variable** Problems in Regression -Multicollinearity, Autocorrelation Heteroscedasticity-Meaning, Nature, Consequences and Remedial Measures, Model Specification and Diagnostic Testing Dummy Variable – Meaning, Nature, Importance and Limitation, Use of Dummy Variable Technique in two and more than two categories Dummy Variable Trap, Interaction effects, Seasonal Analysis, Piecewise Linear Regression,
3	**Dynamic Econometric Models** Lagged Variables and distributed lag models – Meaning, Nature, Importance and Estimation Koyck Approach to Distributed Lag Models- the Adaptive Expectation model and Partial Adjustment Model, Estimation of Autoregressive Models, Method of Instrumental variables, Almon Approach to Distributed Lag Models, Causality in Economics

4	**Simultaneous Equation Models and Time Series Analysis** Simultaneous Equation Model – Meaning, Nature, Consequences, Simultaneous equation bias and inconsistency of OLS estimates; The Identification Problem- Rules of Identification – Order and Rank Conditions Concepts - Stationary, Non-Stationary, Unit roots, Co-integration, Spurious regression, Random Walk Model. Dickey-Fuller and Phillips-Perron approaches to Unit Root test Forecasting with AR, MA and ARIMA Modeling, Box-Jenkins methodology- Identification, Estimation and Diagnostic Test

Books for References:

1. Gujarati D.N., Basic Econometrics, McGraw Hill, New Delhi.
2. Dougherty C (1992), Introduction to Econometrics, oxford University Press, New York.
3. Koutsoyiannis, A. (1977), Theory of Econometrics (2nd ed), The Macmillan Press Ltd., London.
4. Madani, G.M.K. (2000): Introduction to Econometrics: Principles and applications, Oxford University Publications.
5. William H. Greene. (2008) Econometric Analysis. Pearson Education Publication New Delhi
6. Wooldridge, J., (2009) Introductory Econometrics: A Modern Approach, Cengage Learning Publication.
7. Dhanasekaran K., (2014) Econometrics (Ed. 2), Vrinda Publication, New Delhi.

ELECTIVES – 2

(Credit – 4)

LABOUR ECONOMICS

Objectives:

Students in this course will be exposed to issues pertaining to the labour market, employment policies, wage theories, trade unions and collective bargaining and labour and industry relations. This paper will specifically address to, National Labour Commission In India, Migration and the Impact of Globalization, Rationalization, Exit Policy, the Need for Safety Nets, Technological Change and Modernization of Employment in Organized Private Industry, Concepts of Wage Theories, Industrial Disputes, Labour (Trade) Unions are particularly focused in this subject. This paper exposes students to theoretical as well as empirical issues relating to the labour market with special reference to India.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Command an in-depth understanding of rural-urban labour problem & Demand-Supply for Labour in relation to the growth of the Labour market.
2. Acquire a basic understanding of the recent reforms in Labour Legislation and the Status of labour poverty & discuss the Role of Government in Employment, Unemployment & Schemes.
3. A critical understanding of the history of work and theory of Wage theories & Determination.
4. Analyze the relationship between Industrial Relations & State Labour Affairs & Students will develop an understanding of labour as a social relation of production.

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of each Units

Units No.	Content
1	**Labour and Labour Markets** Labour Economics-Definition, Nature and Scope, The Genesis and nature of labour problems, socio-economic importance of labour problems, economic development and labour, Labour problems in a developing economy, Labour problems of agricultural, industrial, women and child labour, labour in unorganized sector, measures taken by government to solve labour problems. Industrial labour and labour Market in India, Economic and Social characteristics, of Industrial labour in India, Migratory character, Low level of Literacy, Low degree of unionization, High rates of absenteeism and Labour turnover, characteristics and growth of labour market in India
2	**Labour-Management Relations** Trade unionism and Structure, Functions and Role of Trade Unions, Rise and Growth of Trade Unions, Trade Unions and Economic Development, Determinants of Trade Union Growth, Nature and Types of Trade Union Leadership, Industrial peace and Industrial Unrest, their implications Industrial Disputes – Meaning, forms, Causes and consequences. Right to Strike and Lockout, Prevention and Settlement of Industrial disputes, Industrial Relations in Public

	Secor, Causes of Poor industrial relations in Public Sector, Machinery for Resolving Disputes in Public Sector
3	**Remunerative Aspect** Demand for and supply of labour, effectiveness of the forces of demand and supply of labour, wages - definition, types, characteristics and efficiency of labour, theories of wages determination, classical and neo-classical theories, demand and supply theory, wage determination under imperfect competition. Exploitation of labour, wages differentials, types and setting of wage differentials, system of wage payments and incentives.
4	**Welfare of Employees** Concepts and Social objectives of welfare state, social security, aims and methods of providing social security, social insurance-origin , growth, elements and importance, social security in India – need, social security schemes in India, Workmen's Compensation Act 1923, Maternity Benefit Act, Employees Provident Fund and Miscellaneous Provisions Act 1952, Housing of Industrial Labour, Unemployment Causes, Types, effects, exit policy and remedial measures, National Labour Commission, Manpower Planning, International Labour Organization,- aims, constitution and various committees.

Books for References:

1. Bhagoliwal T.N. (2002), Economics of Labour and Industrial Relations: Sahitya Bhavan, Agra.
2. Bhatia, S.K. (2005), Constructive Industrial Relations and Labour Laws, B.R. World of Books, New Delhi.
3. Das N. (1950), Unemployment, Full Employment and India, Asia Publishing House, Bombay.
4. Datt, G. (1996), Bargaining Power Wages and Employment: An Analysis of Agricultural Labour Markets in India, Sage Publications, New Delhi.
5. Datt, Rudra (2005), Economic Reforms and Employment, BRW, New Delhi.
6. Deshpande and J C Jandesara (Ed.), Wage Policy and Wage Determination in India, Bombay University, 1970
7. Deshpande L.K., Brahmananda P.R. and E.A.G Robinson (eds), Employment Policy in a Developing Economy, vol.I & II, Macmillan, London, (1983).
8. Ghose, Ajit. K. (2013), Jobs and Incomes in Globalizing World, ILO, Geneva.
9. Hajela, P.D. (1998), Labour Restructuring in India: A Critique of the New Economic Policies. Common Wealth Publishers, New Delhi.
10. Kumar Anil, (2005), Labour Welfare and Social Security, BBW, New Delhi

ELECTIVES – 3

(Credit – 4)

POLITICAL ECONOMY

Objectives: This course explores changes in the organization of production, labour market institutions and corporate structure. It goes on to study the consequences of globalization, especially of financial flows, for the role of the state, economic performance, gender issues, environment, human welfare and development. This course explores the development of the structure and institutions of capitalist economies and their relationship to social and political forces. Students are expected to read some classic texts as well as more recent commentaries.

Learning Outcomes: Upon successful completion of this course, students will be able to:
1. Command an in-depth understanding of Economic systems and its achievements and failures.
2. Acquire a basic understanding of functioning of mixed economy, role of public sector and issues.
3. A critical understanding of the functioning of socialist economy and impact of New Economic Policy.
4. Analyze the success and failure of planning in India

Content of Syllabus

Allocation of Teaching Hours: 20 Hrs. of each Units

Units No.	Content
1	**Introduction and Historical Overview** Different types of Economic systems and their broad features, Capitalism, Communism and Mixed Economy, Economic freedom under these three economies, Achievements and failures of capitalism, Transformation of capitalism into welfare State.
2	**Mixed Economies and their problems** Why mixed economy, Role of public sector, Deficiencies of public sector, coordination between public and private sectors, public sector in India and Radical change in Approach, Features of Sweden's Mixed Economy
3	**The Socialism and New Perspectives** Evolution and growth of Socialism, Marxian Socialism, Liberalization, privatization and globalization, Impact of LPG on Indian economy, inequality and exclusion. Gender in work, Issues in environment and sustainability, Sustainable Development Goals and India's achievements, Role of state
4	**Economic Planning in India** Definition and meaning of planning, Characteristics of economic planning, Role of planning in developed and developing countries, Types of planning, Types of planning on the basis of economic system, time element, region and finance or real output, broad features of India's socialist pattern, Gandhian economics, Economic philosophy of Sarvodaya and its limitations, Role of NITI Aayog

Books for References:

1. Fran Tonkiss, Contemporary Economic Sociology: Globalisation, Production, Inequality, Routledge India 2008

2. G. Gereffi, J. Humphrey and T. Sturgeon, 2005, —The Governance of Global Value Chains Review of International Political Economy, Volume 12
3. Andrew Glyn, —Challenges to Capital, in Capitalism Unleashed: Finance, Globalization and Welfare, Oxford: Oxford University Press, (Ch One, pp. 1-24), 2006.
4. Gary Dymsky, 2005, —Financial Globalization, Social Exclusion and Financial Crisis, International Review of Applied Economics, Vol. 19
5. E. Stockhammer, —Financialization and the Global Economy, in G. Epstein and M.H. Wolfson (ed.) The Political Economy of Financial Crises, Oxford University Press, 2010.
6. J. Gurley, "The Materialist Conception of History", in R. Edwards, M. Reich and T. Welsskopf (ed.), The Capitalist System, 2nd edition, 1978.
7. O. Lange, Political Economy, vol. 1, 1963,.
8. R.L. Heilbroner, "Capitalism", in The New Palgrave Dictionary of Modern Economics, Macmillan, 1987.
9. P. Sweezy, The Theory of Capitalist Development, Monthly Review Press, 1942,
10. Anwar Shaikh, Entries on "Economic Crises" and "Falling Rate of Profit" in T. Bottomore et al (eds.), The Dictionary of Marxist Thought, OUP, Indian edition, Maya Blackwell, 2000.
11. J. Schumpeter, Capitalism, Socialism and Democracy, George Allen and Unwin 1976,
12. P. Baran (1957), The Political Economy of Growth, Pelican edition, 1973.
13. Amit Bhaduri, —Nationalism and Economic Policy in the Era of Globalization, Deepak Nayyar (ed), Governing Globalization: Issues and Institutions, OUP, 2002